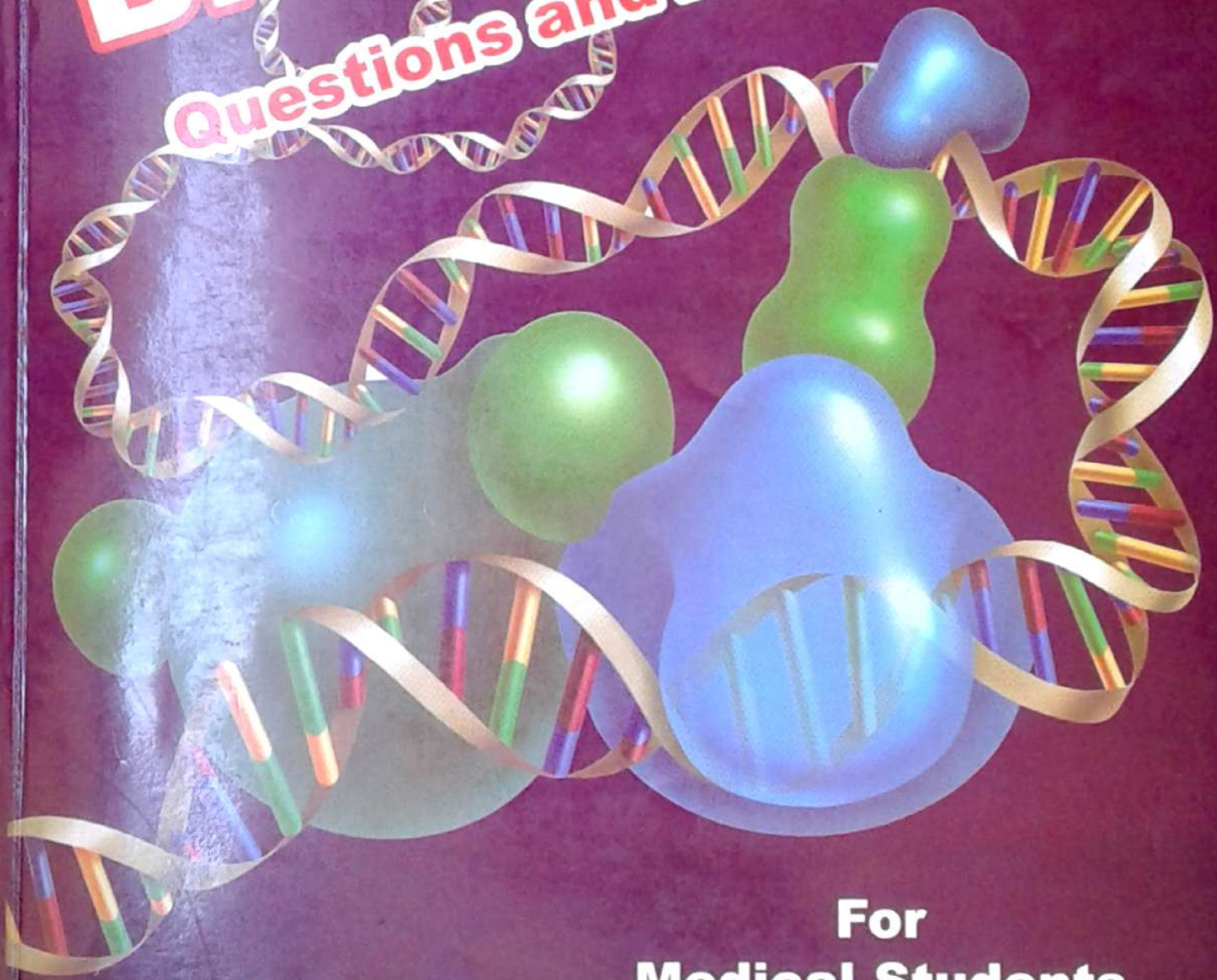
Oraby's Illustrated Reviews of Biochemistry

Questions and Answers



For Medical Students and Postgraduates Part IV (Volume 1)

CONTENTS (volume 1)

CONTENTS (volume 2)

Chapter 1 *Carbohydrate Chemistry*

1. *What are carbohydrates?*
   A. These are aldehyde or ketone derivatives of polyhydric alcohols, or any substance derived from them.
2. *How Carbohydrates are classified?*
   A. According to the number of the sugar units available, carbohydrates are classified as monosaccharides, disaccharides, oligosaccharides, and polysaccharides.
3. *What are monosaccharides?*
   A. Carbohydrates formed of one sugar unit.
4. *What are disaccharides?*
   A. Carbohydrates formed of 2 sugar units.
5. *What are oligosaccharides?*
   A. Carbohydrates formed of 3-10 sugar units.
6. *What are polysaccharides?*
   A. Carbohydrates formed of more than 10 sugar units.
7. *How are sugar units combined together?*
   A. Through glycosidic linkages.
8. *What is glycosidic bond?*
   A. It is the bond between a carbohydrate and another compound to form a complex carbohydrate e.g. sugar and sugar as maltose, or sugar and non-carbohydrate as ATP and cardiac glycosides.
9. *How are monosaccharides further classified?*
   A. Sugars having aldehyde group (aldoses) and sugars having keto group (ketoses).
10. *Name some important monosaccharides.*
    A. Glucose, fructose, galactose and mannose.
11. *What are pentoses?*
    A. Monosaccharides with five carbon atoms.
12. Name some pentoses.
    A. Ribose, deoxyribose, xylose, arabinose and lyxose.

13. *What are the functions of Lyxose?*

A. It is constituent of a lyxoflavin isolated from human heart muscle.

14. *What are the functions of ribose and deoxyribose?*

A. (1) They enter in the structure of nucleic acids (DNA and RNA) (2) Ribose enters in the structure of ATP, GTP and other high energy phosphate compounds (3) Ribose enters in the structure of coenzymes NAD, NADP and flavoproteins.

15. *Which is the reference carbon atom in sugars?*

A. It is the carbon atom next to last $-CH_2OH$ e.g. carbon atom number 5 in glucose.

16. *Define reference sugar:*

A. It is the *glyceraldehyde* which may be present in *(D)* form in which –OH group attached to asymmetric carbon atom is on the right side and *(L)* form in which the same –OH group is on the left side.

17. *What is the difference between D and L sugars?*

A. They are mirror images of one sugar depending on the position of –OH group attached to reference carbon atom e.g. carbon atom number 5 in glucose. If the –OH group attached to 5th carbon is on the right side, it is *(D)* form of glucose and If the –OH group is on left side, it is *(L)* form of glucose.

18. *Which isomer is common in nature?*

A. D forms of sugars are common in nature.

19. *Which is the most common monosaccharide in the body?*

A. Glucose.

20. *What are the functions of glucose?*

A. Glucose is the major source of energy in mammals. In the liver and other tissues, glucose is converted to all carbohydrates in the body e.g. glycogen, galactose, ribose and fructose.

21. *What are the functions of fructose?*

A. Fructose is a source of 15% of energy in mammals. It is the sugar of semen.

22. *What are the functions of galactose?*

A. It enters in the structure of lactose, glycolipids, glycoproteins and proteoglycans.

23. *What is the difference between glucose and galactose?*

A. They are epimers. They are different with regard to the H and OH groups at the 4^{th} carbon atom. Galactose is the 4^{th} epimer of glucose.

24. *Galactose is present in which food?*

A. In milk, which contains lactose that is formed of galactose and glucose.

25. *Where can galactose be synthesized from glucose?*

A. In many tissues as in mammary gland to make the lactose (milk sugar).

26. *What is asymmetric carbon atom?*

A. Is that carbon atom to which 4 different groups or atoms are attached.

27. *What are the properties given by a substances containing asymmetric carbon atoms?*

A. 2 properties, optical activity and optical isomerism.

28. *What is optical activity?*

A. It is the ability of a substance containing asymmetric carbon atom to rotate plane-polarized light either to the right or to the left.

29. *What are types of optically active substances?*

A. Dextrorotatory and levorotatory.

30. *What do you mean by dextrorotatory and levorotatory substances?*

A. Dextrorotatory is the substance that rotates plane polarized light to the right. Levorotatory is the substance that rotates it to the left.

31. *What is Specific rotation?*

A. It is the angle of rotation specific for each optically active substance when the concentration of substance is 100 g/dl and the length of measuring tube is 10 cm.

32. *What is the specific rotation of glucose and frucose?*

A. For glucose is (+52.5°) and for fructose is (-91°).

33. *What is racemic mixture:*

A. It is the mixture containing equal number of molecules of 2 optically active sugars, one is dextrorotatory and the other is levorotatory. Thus, it shows no optical activity (provided that the angle of rotation is equal in both sides).

34. *What is resolution:*

A. It is the separation of optically inactive racemic mixture into its optically active substances.

35. *What is optical isomerism:*

A. It is the ability of a substance to be present in more than one form (isomer).

36. How many isomers for a substance?

A. A substance containing one asymmetric carbon atom has 2 isomers, A substance containing 2 or more asymmetric carbon atoms can exist in a number of isomers $=2^n$ where n is the number of asymmetric carbon atoms.

37. How many isomers for glucose?

A. glucose has 4 asymmetric carbon atoms so the number of its isomers equal $2^4 = 2 \times 2 \times 2 \times 2 = 16$ isomers.

38. What is anomeric carbon:

A. It is the asymmetric carbon atom obtained from active carbonyl sugar group: carbon number 1 in aldoses and carbon number 2 in ketoses.

39. What are anomers?

A. These are isomers obtained from the change of position of hydroxyl group attached to the anomeric carbon.

40. Give examples of anomers.

A. α-Glucose and β-glucose are anomers. Also α and β fructose are anomers.

41. What is the difference between α and β anomers?

A. In α anomers, the hydroxyl group attached to the carbonyl carbon is to the right. In β anomers, the hydroxyl group attached to the carbonyl carbon is to the left.

42. What is epimeric carbon?

A. It is the asymmetric carbon atom other than carbon of aldehyde or ketone groups e.g. carbons number 2,3 and 4 of glucose.

43. What are epimers?

A. They are isomers resulting from the change in positions of –H and –OH groups around the epimeric carbons.

44. Give example of epimers.

A. Glucose, mannose and galactose are epimers. Glucose and mannose are epimers, which differ only with respect to carbon atom 2. Glucose and galactose are epimers, which differ only with respect to carbon atom 4.

45. What is the mutarotation?

A. It is a gradual change of specific rotation of any optically active substance having free aldehyde (-CHO) or ketone (C=O) group.

46. What is the basis of mutarotation?

A. It is due to presence of anomeric carbon atom.

47. *Give example of mutarotation.*

A. α – glucose freshly dissolved in water, has specific rotation of +112°. β – Glucose when freshly dissolved in water, has specific rotation of +19°. When both anomers are left for some time, α and β sugars slowly change into an equilibrium mixture which contain α, β and open chain forms and has specific rotation of + 52.5°.

48. *What is the difference between glucose and fructose?*

A. Glucose is an aldohexose, and fructose is a ketohexose.

49. Name a ketose.

A. Fructose.

50. *What is the principle of Benedict's test?*

A. In alkaline medium, sugar will cause reduction of a blue colored reagent (containing cupric ions) to form red colored precipitate (containing cuprous ions). → راسب ملون

51. *What is the composition of Benedict's reagent?*

A. It contains sodium carbonate, copper sulfate and sodium citrate. In the alkaline medium provided by sodium carbonate, the copper remains as cupric hydroxide. Sodium citrate acts as a stabilizing agent to prevent precipitation of cupric hydroxide.

52. *Benedict's test is commonly employed for what?*

A. To detect the presence of glucose in urine.

53. *Name a few reducing sugars.*

A. Glucose, fructose, and mannose.

54. *What are sugars that can give positive Benedict test?*

A. These are sugars containing free aldehyde or ketone group.
Cupric (blue) + sugar → Cuprous (red) + oxidized sugar

55. *What are the common properties of monosaccharides?*

A. All are soluble in water, all can present in α and β forms, all are reducing, all can form osazone crystals and all undergo mutarotation.

56. *Glucose and fructose will form identical osazones, why?*

A. The difference in glucose and fructose lies in the first and second carbon atoms, and this is masked by the osazone formation.

57. *On oxidation of glucose, what are produced compounds?*

A. Glucoronic acid, gluconic acid and glucosaccharic acid.

58. *How can glucuronic acid is produced?*

A. By oxidation of last hydroxyl carbon (C6).

59. *How can gluconic acid is produced?*

A. By oxidation of carbonyl carbon (C1).

60. How can glucosaccharic acid is produced?

A. These are dicarboxylic acids produced by oxidation of both carbonyl carbon and last hydroxyl carbon (C1 and C6).

61. *What are the reaction products of reduction of sugars?*

A. Reduction of carbonyl group gives the corresponding alcohol.

62. *Reduction of glucose produces what?*

A. Sorbitol.

63. *Reduction of fructose produces what?*

A. Sorbitol.

64. *Reduction of ribose produces what?*

A. Ribitol.

65. *Reduction of galactose produces what?*

A. Galacticol.

66. Name some deoxy sugars.

A. Deoxy ribose and fucose (deoxy galactose).

67. *What are the reaction products of glucose with phosphoric acid?*

A. Phosphate esters e.g. glucose-6-phosphate and glucose-1-phosphate.

68. *What are the reaction product of glucose with sulfuric acid?*

A. Furfural.

69. *What is the principle of Molish's test?*

A. Sulfuric acid is a dehydrating agent, removing 3 molecules of H_2O from the sugar giving a compound called furfural. This compound can condense with α–naphthol to give a violet ring. This is the idea of Molish's test, a general test for all carbohydrates.

70. *What are the products of reaction of monosaccharides with phenylhydrazine?*

A. Osazone crystals. All sugars having free carbonyl group can form osazone crystals.

71. *How many sugar units are present in disaccharides?*

A. Two.

72. *Name some important disaccharides.*

A. Sucrose, lactose, maltose, isomaltose, cellobiose, trehalose.

73. *Which is the sugar found in milk?*

A. Lactose.

74. *What is the glycosidic linkage in lactose?*

A. β 1→ 4 linkage.

75. *Glucose and fructose are reducing sugars, but sucrose (containing glucose and fructose) is a non-reducing sugar, why?*

A. Because the glycosidic linkage in sucrose involves 1st carbon of glucose and 2nd carbon of fructose, so both reducing groups are masked.

76. *Hydrolysis of maltose will give rise to what?*

A. Two glucose units.

77. *What is the glycosidic linkage in maltose?*

A. α 1 → 4 glycosidic bond.

78. *What are the monosaccharide components of lactose?*

A. Galactose and glucose.

79. *Which disaccharides have no free aldehyde or ketone group?*

A. Sucrose and trehalose.

80. *What are the hydrolytic products of sucrose?*

A. α-glucose + β-fructose.

81. *What is the glycosidic linkage in sucrose?*

A. 1→ 2 linkage.

82. *Which are the sources of sucrose?*

A. Cane and beets.

83. *What are the hydrolytic products of trehalose?*

A. α- glucose + α-glucose (α 1→ 1 glycosidic linkage).

84. *What are the hydrolytic products of cellobiose?*

A. β-glucose+ β-glucose (β 1→ 4 glycosidic linkage).

85. *What are the hydrolytic products of ismmaltose?*

A. α- glucose + α-glucose(α 1→ 6 glycosidic linkage).

86. *Name reducing disaccharides.*

A. Lactose, maltose, cellobiose and isomaltose.

87. *Name non-reducing disaccharides.*

A. Sucrose and trehalsoe.

88. *Enumerate disaccharides formed of 2 glucose units.*

A. Maltose, isomaltose, cellobiose and trehalose.

89. *How many sugar units are present in polysaccharides?*

A. More than 10 sugar units.

90. *How polysaccharides are classified?*

A. Homopolysaccharides (homoglycans) and heteropolysaccharides (heteroglycans).

91. *What is a homopolysaccharide?*

A. They are composed of single kind of repeated monosaccharides.

92. *Give examples of homopolysaccharides.*

A. Starch, and glycogen.

93. *What are the hydrolytic products of starch?*

A. Glucose units.

94. *What are the hydrolytic products of glycogen?*

A. Glucose units.

95. *What are the characteristics of glycogen?*

A. It is composed of glucose units. It is the stored form of carbohydrate in animal kingdom. It has a highly branched structure.

96. *What are the glycosidic linkages present in starch and glycogen?*

A. α 1,4 α 1,6.

97. *What is the reserve carbohydrate in plant kingdom?*

A. Starch.

98. *What is the end product of action of pancreatic amylase on starch?*

A. Maltose.

99. *Cellulose and starch are polysaccharides made of glucose, but cellulose* cannot be digested by human beings, why?

A. Cellulose contains beta 1,4 linkages, which cannot be digested by human enzymes.

100. *What is inulin?*

A. It is a homopolysaccharide, composed of fructose units.

101. *What is the medical use of inulin?*

A. Inulin clearance is used as one of kidney function tests. It measures glomerular filtration rate.

102. *What are sources of inulin?*

A. Root of artichokes and other plants.

103. *What are heteropolysaccharides?*

A. They are composed of two or more different monosaccharides.

104. *Give examples of heteropolysaccharides.*

A. Glycosaminglycans (*mucopolysaccharides).*

105. *What are glycosaminoglycans?*

A. They contain uronic acid and amino sugars.

106. *Enumerate glycosaminoglycans you know.*

A. Hyaluronic acid, chondroitin sulfate, keratan sulfate, *dermatan* sulfate, heparin and heparan sulfate.

107. *Which glycosaminoglycans do not contain uronic acid?*

A. Keratan sulfate.

108. *What are the hydrolytic products of keratan sulfate?*

A. The repeated disaccharide unit consists of galactose (no uronic acid), with sulfate on C_6 and N-acetylglucosamine with sulfate on C_6.

109. *What are the functions of keratan sulfate?*

A. It plays an important role in corneal transparency.

110. *Hyaluronic acid is seen in which tissues?*

A. Connective tissue, synovial fluid, tendons, and vitreous humor.

111. *What are the hydrolytic products of heparin?*

A. The repeated disaccharide unit consists of L-induronic acid with sulfate on C_2 and glucosamine with sulfate on C_3 and C_6.

112. *What are the functions of heparin?*

A. It acts as anticoagulant.

113. *What is heparan?*

A. Heparan sulfate (which *has the same structure as heparin except some glucosamines are acetylated with fewer sulfate groups).*

114. *What are the functions of heparan?*

A. It is a component of cell membrane and act as a receptor . It participates in cell adhesion and cell-cell interaction. It is present also in basement membrane of the kidney and plays an important role determining the charge selectiveness of glomerular filtration.

115. *What are the hydrolytic products of hyaluronic acid?*

A. Repeated disaccharide unit consists of glucuronic acid and N-acetylglucosamine.

116. *What are the functions of hyaluronic acid?*

A. It makes extracellular matrix loose because of its ability to attract water, It makes cartilage compressible, It acts as a lubricant in joints and It permits cell migration during wound repair and morphogenesis,

117. *What are the hydrolytic products of chondroitin-4-sulfate?*

A. Repeated disaccharide unit consists of glucuronic acid and N-acetylglucosamine.

118. *What are the functions of chondroitin sulfate?*

A. It helps to maintain the shape of skeletal system, It has a role in compressibility of cartilage in weight bearing and In cartilage it binds collagen and hold fibers in strong network.

119. *What are the hydrolytic products of dermatan sulfate ?*

A. The repeated disaccharide unit consists of L-induronic acid and N-acetylgalactosamine with sulfate on C_6.

120. *What are the functions of dermatan sulfate?*

A. In cornea, it plays-together with keratan sulfate, an important role in corneal transparency. Its presence in sclera may play a role in maintaining the overall shape of the eye.

121. *What are the differences between glycoproteins and proteoglycans?*

	GLYCOPROTEINS	PROTEOGLYCANS
A-Structure 1-Carbohydrate component:	Oligosaccharide units	Glycosaminoglycans
2-Types of sugar:	Contain no uronic acid	Contain uronic acid as glucuronic and induronic acids.
	Acetylhexosamine	Acetylhexosamine.
	Hexoses as galactose and mannose	Hexoses as galactose.
	Pentoses: as arabinose and xylose.	Sugar amines as glucosamines.
	Methylpentoses: L-fucose	
3-Sulfate group:	Contain no sulfate	Contain sulfate.
4-Size of carbohydrate component:	2 – 15 units.	More than 50 units.
5-Repeating structure:	Little or none.	Repeating disaccharides.
6-Shape of carbohydrate component:	Usually branched	Linear, unbranched.
B-Functions:	Extracellular matrix Mucin. Blood group antigens e.g. A, B and AB. Cell receptors. Glycophorins. Plasma proteins. Some hormones. Enzymes. Antibodies "immunoglobulins	1)Ground substances and supporting tissues as cartilage, bones and tendons. 2)Cell membrane.

122. *Compare between glucose and fructose.*

	Glucose (dextrose)	Fructose (Levulose)
Active carbonyl group	Aldehyde group	Ketone group
Sources	Grape	Onion and other friuts
Optical activity	Dextrorotatory	Levorotatory
Function	Blood sugar	Semen sugar
Ketose test	Ve-	Ve+

123. *What are the differences e between keratan sulfate, creatine, creatinine, keratin, carnitine and carnosine?*

	NATURE (STRUCTURE)	FUNCTION
Keratan sulfate	Glycosaminoglycans (Carbohydrate)	Plays an important role in corneal transparency.
Creatine	Methyl guanido acetic acid (amino acid derivative)	Creatine phosphate is a source of energy in muscles.
Creatinine	Anhydrous creatine	End product of creatine, excreted in urine.
Keratin	Simple protein	Present in hair, nail and skin
Carnitine	β hydroxy γ trimethyl amino butyric acid	Fatty acid carrier
Carnosine	Results from conjugation of histidine and β-alanine	Unknown

124. *Compare between glycogen, cellulose and starch:*

	Glycogen	Cellulose	Starch
Units	α Glucose	β Glucose	α Glucose
Structure	branching chains (α 1,4 and α 1,6).	Non-branching chains (β 1,4).	Amylose: non-branching chains (α 1,4). Amylopectin: branching chains (α1,4 and α 1,6).
Enzyme digestion by:	Salivary and pancreatic amylase	Not digested	Salivary and pancreatic amylase
Iodine reaction	Violet color	No color	Blue color
Functions	Storage form of carbohydrate mainly in liver to maintain blood glucose in between meals.	*Supportive element in plants. *Makes stool bulky and prevent constipation.	Storage form of carbohydrate in plants. It is the main sources of carbohydrates for animals and human.

125. *Compare between Sucrose and invert sugar:*

	Sucrose	Invert sugar
Sources:	Sugar of cane and beet	Sugar of bee honey
Structure:	Formed of α-glucose and β-fructose linked together by 1 – 2 linkage.	Formed of mixture contains the same number of glucose and fructose.
Optical activity:	Dextrorotatory.	Levorotatory
Properties:	Contains <u>no</u> free carbonyl group, so It is <u>not</u> a reducing sugar. ➢ It cannot be present in α and β forms. ➢ It cannot show mutarotation. ➢ It cannot form osazone crystals.	Contains free carbonyl groups, so it is a reducing sugar. ➢ It can be present in α and β forms. ➢ It can show mutarotation. ➢ It can form osazone crystals.

126. *Compare between maltose, sucrose and lactose.*

	Maltose	Lactose	Sucrose
Other name	Malt sugar	Milk sugar	Table, beet or cane sugar
Units	2 Glucose units	Glucose+ Galactose	Glucose+Fructose
Bond	α 1,4 Glucosidic	β 1,4 Galactosidic	α 1-Glucose β 2-fructose
digestion by	Maltase	Lactase	Sucrase
Free carbonyl group	Present	Present	Absent
Optical activity, mutarotation and reduction of Benedictict's	Ve+	Ve+	Ve-

MCQ, Matching, True and False and Completion

Select and encircle the most appropriate answer or completion:

1) Hydrolysis of sucrose yields:

A) Only glucose
B) Only galactose
C) Galactose and glucose
D) Fructose and glucose
E) Only fructose

2) Heparin is:

A) A disaccharide
B) An oligosaccharide
C) A sulfated mucopolysaccharide
D) An amino sugar
E) A heptulose

3) Ribitol is:

A) Deoxy sugar
B) Sugar alcohol
C) Amino sugar
D) Sugar acid
E) Sugar phosphate

4) Which of the following is a ketose?

A) Galactose
B) Fructose
C) Fucose
D) Mannose
E) Xylose

5) Glucose is:

A) Source of energy
B) Not reducing sugar
C) Ketohexose
D) Not optically active
E) Pentosugar

6) Lactose is:

A) Milk sugar
B) Milk protein
C) Blood sugar
D) Semen sugar
E) Non reducing sugar

7) Digestion of dietary starch produces all the following compounds EXCEPT:

A) Maltose
B) Lactose
C) Amylodextrin dextrin
D) Achrodextrin
E) Isomaltose

8) Gluconic acid, gluccharic acid and glucuronic acid are produced from glucose by:

A) Reduction
B) Oxidation
C) Hydrolysis
D) Hydroxylation

9) Hydrolysis of lactose produces:

A) Two molecules of glucose
B) Glucose and fructose
C) Glucose and galactose
D) Glucose and mannose
E) Galactose and mannose

10) Contain(s) more α (1-6) than α (1-4) linkages.

A) Muscle glycogen
B) Liver glycogen
C) Both of them.
D) Neither of them

11) Fucose is:

A) Aldopentose
B) Ketohexose
C) deoxysugar
D) Disaccharide
E) Homopolysaccharide

12) Hyaluronic acid is:

A) Glycoprotein
B) Sulfated glucuronic acid
C) Repeated disaccharide formed of glucuronic acid and N-acetyl glucosamine
D) High molecular weight positively charged homopolysaccharide
E) Lipoprotein

13) Glucose:

A) is a ketose
B) has an anomeric carbon number 2
C) forms a part of disaccharide sucrose
D) is reduced to form mannitol
E) is usually present in furanose form

14) Amylose is formed of:

A) α 1-4 glucose residues
B) β 1-4 glucose residues
C) α 1-4, α 1-6 glucose residues
D) β 1-4, β 1-6 glucose residues
E) α 1-1, glucose residues

15) Amylose is:

A) Branched homopolysaccharide
B) Linear homopolysaccharide
C) Linear heteropolysaccharide
D) A salivary enzyme
E) Pancreatic enzyme

16) Glycogen contains:

A) More β 1,4 than β 1,6 bonds
B) More β 1,6 than β 1,4 bonds
C) More α 1,4 than α 1,6 bonds
D) More α 1,6 than α 1,4 bonds
E) An equal number of 1,4 and 1,6 bonds

17) Sucrose is:
- A) A fructose polymer
- B) A disaccharide containing glucose and fructose
- C) A reducing disaccharide
- D) Can undergo mutarotation
- E) Can form osazone crystals

18) A sulfate group can be obtained by hydrolysis of:
- A) Heparin
- B) Hyaluronic acid
- C) Fucose
- D) Sialic acid
- E) Inulin

19) The two sugar units of disaccharides are connected by:
- A) O-Glycosidic bond
- B) N-Glycosidic bond
- C) Peptide bond
- D) Phosphodiester bond
- E) Disulfide bond

20) The following carbohydrates are formed of glucose units only EXCEPT:
- A) Glycogen
- B) Cellulose
- C) Maltose
- D) Lactose
- E) Starch

21) The D configuration of a sugar is based on its analogy to:
- A) D-Glucose
- B) α D-glucose
- C) D-Fructose
- D) D-Ribose
- E) D-Glyceraldehyde

22) For a compound to be optically active it must be:
- A) Colored
- B) A protein
- C) Symmetric
- D) Asymmetric
- E) Plant in nature

23) D-Glucose is bases on position of (-OH) to the right at:
- A) Carbon (1)
- B) Carbon (2)
- C) Carbon (3)
- D) Carbon (5)
- E) Carbon (6)

24) If you dissolve pure crystals of glucose in water and leave the solution for equilibrium, the solution will contain:
- A) α-Glucose only
- B) β-Glucose only
- C) Open chain glucose only
- D) A mixture of α-glucose and β-glucose
- E) A mixture of α, β and open chain glucose

25) The sugar present in cane is formed by combination of α-glucose and β-fructose through a linkage between the following carbons:
A) 1-2
B) 1-4
C) 1-6
D) 2-6
E) 2-3

26) A homopolysaccharide formed of β glucose units is:
A) Starch
B) Dextrin
C) Cellulose
D) Cellobiose
E) Inulin

27) Glycosaminoglycans:
A) Contain repeated monosaccharides
B) Contain repeated disaccharides
C) Contain no sulfate groups
D) Contains branches of N-acetylneuraminic acid
E) Contain no uronic acids

28) Inulin is a polymer of:
A) Glucose
B) Galactose
C) Mannose
D) Fructose
E) Ribose

29) Honey contains which of the following sugars:
A) Sucrose
B) Maltose
C) Isomaltose
D) Invert sugar
E) Lactose

30) The following are properties of lactose EXCEPT:
A) It is a nonreducing sugar
B) Can undergo mutarotation
C) Formed of α-glucose and β-galactose
D) Can reduce Benedict's reagent.
E) Can form osazone

31) Sorbitol is produced by reduction of:
A) Glucose or fructose
B) Glucose or galactose
C) Glucose or mannose
D) Galactose or fructose
E) Galactose and xylulose

32) Which of the following is a glycosaminoglycans:
A) Inulin
B) Heparin
C) Glucosamine
D) Galactosamine
E) Sialic acid

33) Glucose and galactose are epimers. This means that:

A) They are mirror images of each other.
B) One is pyranose and the other is furanose.
C) They rotate plane polarized light in opposite directions.
D) They differ only in the configuration about carbon atom number 2.
E) They differ only in the configuration about carbon atom number 4.

34) Hydrolysis of Lactose yields:

A) Glucose only
B) Glucose and galactose
C) Glucose and fructose
D) Fructose and galactose
E) Fructose only.

35) Starch and glycogen are both polymers of:

A) Glucose
B) Fructose
C) Mannose
D) Galactose
E) Ribose

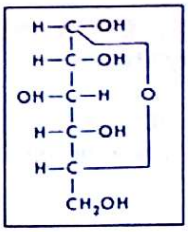
36) The reference sugar is:

A) Glucose
B) Fructose
C) Mannose
D) Ribulose
E) Glyceraldehyde

37) Which of the following is a nonreducing sugar:

A) Maltose
B) Sucrose
C) Lactose
D) Cellobiose
E) Isomaltose

38) The structure shown beside is that of:



A) α-D-glucopyranose
B) β-D-glucopyranose
C) α-D-glucofuranose
D) β-L- glucofuranose
E) α-D-fructofuranose

39) Osazone formation, mutarotation and reducing property are all based on the presence of:

A) Presence of α form
B) Presence of β form
C) Presence of free carbonyl group
D) Presence of D configuration
E) Presence of cyclic structure form

40) The invert sugar is:

A) Hydrolysis product of Lactose
B) Hydrolysis product of maltose
C) Hydrolysis product of sucrose
D) Hydrolysis product of Cellobiose
E) Hydrolysis product of terahalose

41) The cane sugar is similar to:

A) Malt sugar
B) Milk sugar
C) Beet sugar
D) Grape sugar
E) Invert sugar

In the following questions indicate with clear (T) the true statements, and with clear (F) the false statements:

For sugars:

42. Sucrose is a non reducing sugar
43. Glucose and mannose are epimers
44. Fructose is the main blood sugar
45. Amino sugars are important constituents of proteoglycans
46. Heparin is a glucosaminoglycan act as anticoagulant

The following are ketose sugars:

47. Mannose
48. Galactose
49. Fructose
50. Ribulose
51. Deoxyribose

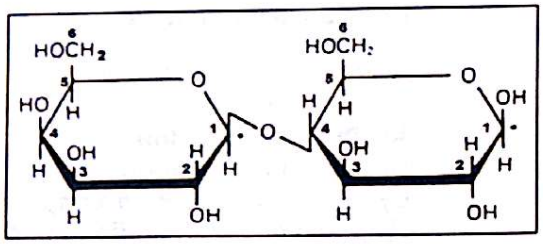
The following compounds contain sugar residues:

52. ATP
53. Lecithin
54. NAD+
55. RNA
56. Glutathione

Carbon 1 of glucose may be:

57. Phosphorylated
58. Oxidized
59. Linked to UDP
60. Linked to amino group
61. Reduced

The sugar shown beside:



62. Contains a β-1,4 glycosidic bond
63. Is a reducing sugar
64. May undergo mutarotation
65. Contains a furanose ring
66. Is a sugar present in cane

The sugar shown in previous question:

67. Is derived from the digestion of starch by pancreatic α-amylase
68. Is hydrolyzed to monosaccharides by sucrase
69. Is found at a branch point in starch
70. Is hydrolyzed to glucose and galactose
71. Is hydrolyzed to glucose and fructose

Carbohydrates are usually:

72. aldehyde or ketone derivatives of polyhydric alcohols
73. are distributed only in animal tissues
74. Red liquids
75. Rarely soluble in organic solvents
76. Soluble in water

For polysaccharides:

77. Are formed of more than 10 monosaccharides and linked together by glycosidic
78. Polysaccharides are high molecular weight polymers of glucose
79. Some polysaccharides when hydrolyzed yield mixture of hexoses and hexoses derivatives
80. Homopolysaccharides are high molecular weight polymers of hexoses and hexose derivatives
81. Polysaccharides may be attached to protein molecule to form proteoglycans.

For carbohydrates are usually:

82. Reduction of aldoses or ketoses yields polyhydric alcohols
83. Lactose is not a reducing sugar
84. Sucrose is not a reducing sugar
85. Glycosides are the condensation product of the hydroxyl group of an anomeric carbon with alcohol
86. Polysaccharides may contain acetyl, sulfhydryl, and phosphate groups

Matching: For each set of numbered questions, choose the ONE BEST answer from the list of lettered options below it. An answer may be used once or more times, or not at all.

87. *Epimers*
88. *Anomers*
89. *Invert sugar*
90. *Reference sugar*
91. *Sugar acid*

A. α-Glucose and β-glucose
B. Glyceraldehyde
C. Homopolysaccharides
D. Glucose, galactose and mannose
E. Formed of an equal number of glucose and fructose molecules
F. Formed of four sugar units.
G. Glucuronic acid

92. *Sucrose*
93. *Maltose*
94. *Lactose*
95. *Invert sugar*
96. *Cellobiose*

A. Fructose only
B. Glucose only
C. Glucose and fructose
D. Glucose and galactose
E. Fructose and galactose

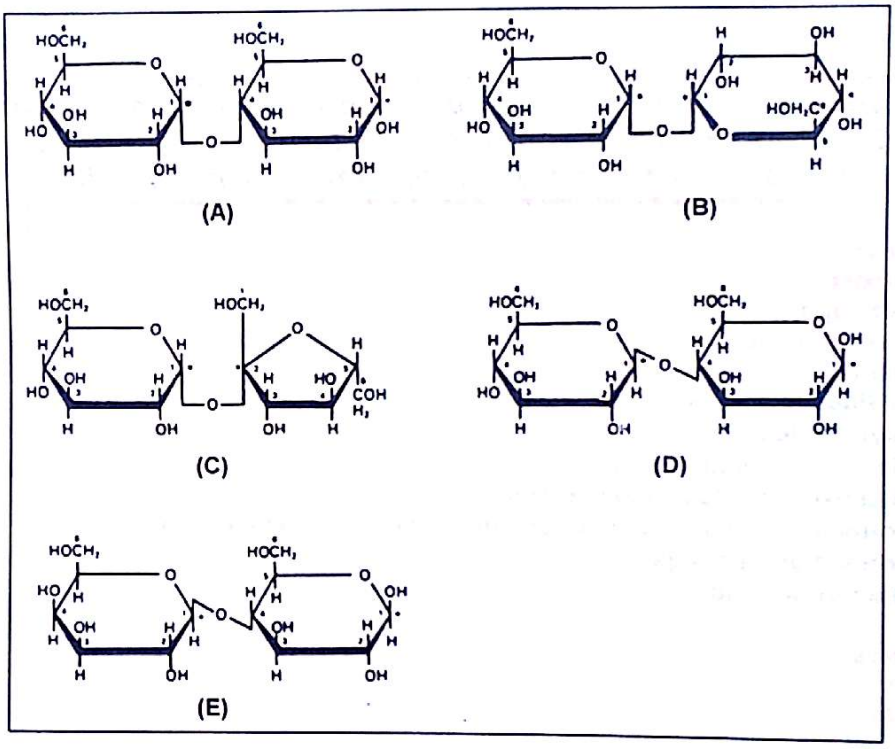
97. *Keratan sulfate*
98. *Dermatan sulfate*
99. *Hyaluronic acid*
100. *Heparin*
101. *Chondroitin sulfate*

A. Binds collagen and holds fibers in strong network.
B. Present in scletra and maintain the overall shape of the eye
C. Acts as a lubricant in joint
D. Corneal trancparency
E. Anticoagulant

102. *6 - Deoxygalactose*
103. *Essential for collagen synthesis*
104. *A Constituent of the polysaccharides of cartilage.*
105. *Occurs with glucouronic acid in hyaluronic*
106. *Derivative of neuraminic acid*

A. N-Acetylgalactosamine
B. Ascorbic acid
C. N-Acetylglucosamine
D. L-fucose
E. Sialic acid

107. *Trehalose*
108. *Cellobiose*
109. *Maltose*
110. *Lactose*
111. *Sucrose*



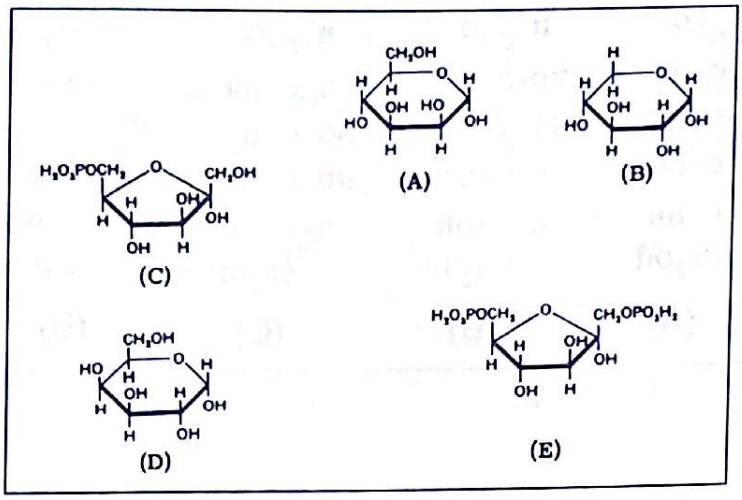
112. *Lactose*
113. *Sucrose*
114. *Maltose*
115. *Cellobiose*

A. α-Glucose and α-glucose
B. β-Glucose and β-glucose
C. α-Glucose and β-galactose
D. α-Glucose and β-fructose

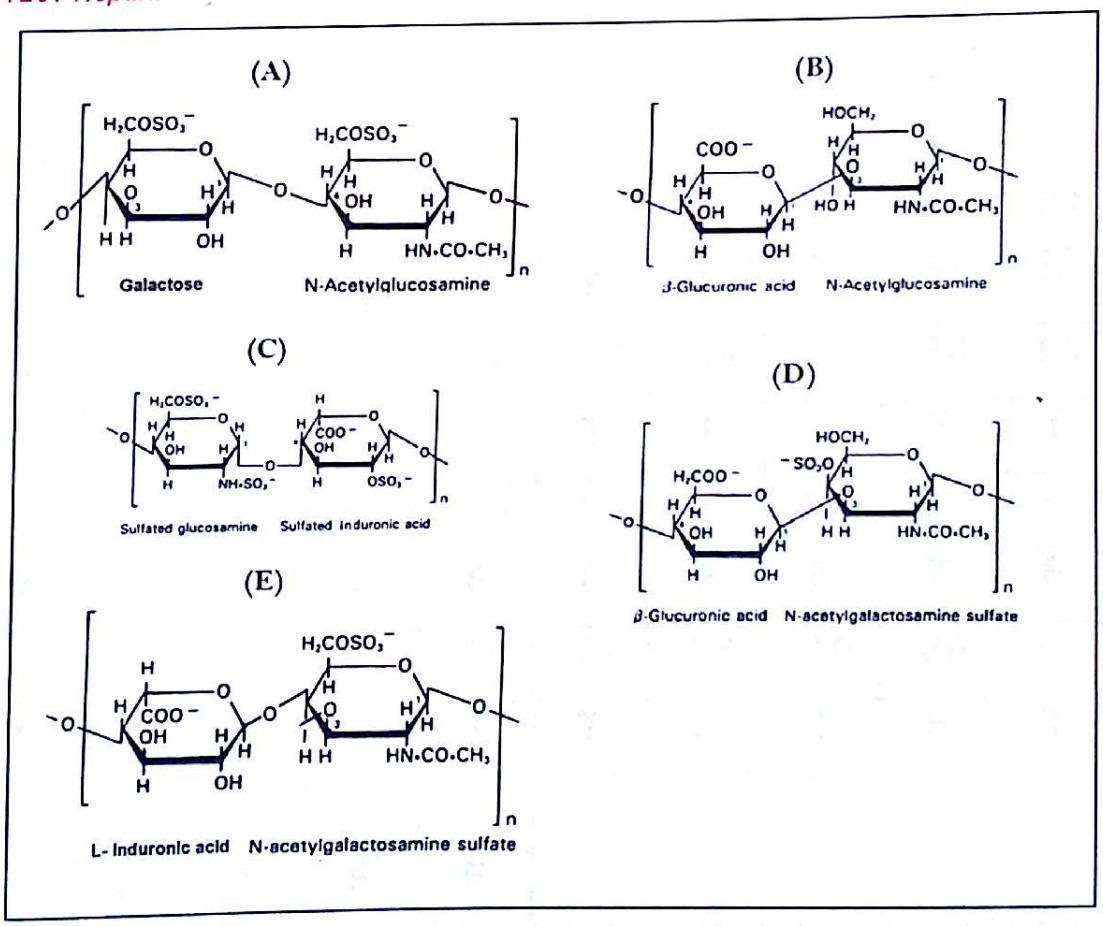
116. *Lactose*
117. *Heparin*
118. *Starch*
119. *Mannose*

A. Monosaccharide
B. Glycosaminoglycans
C. Disaccharide
D. Homopolysaccharide

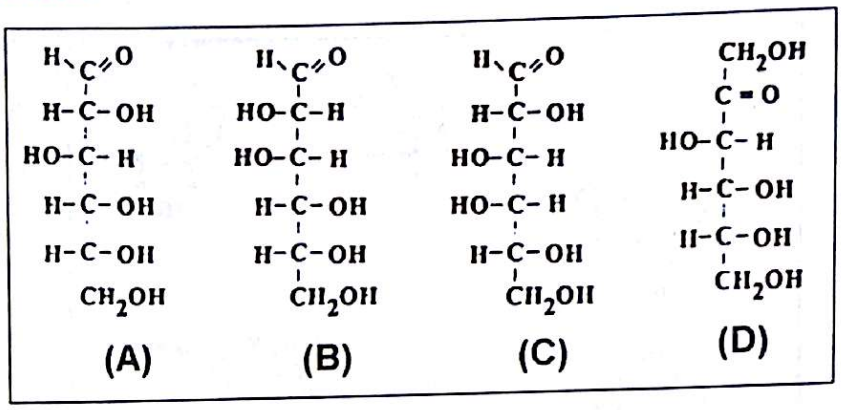
120. *α - D-galactopyranose*
121. *α - D-mannopyranose*
122. *Fructose-6-phosphate*
123. *Fructose 1,6 bisphosphate*
124. *α - D-xylopyranose*



125. *Dermatan sulphate*
126. *Chondriotin sulphate*
127. *Hyaluronic acid*
128. *Keratan sulfate*
129. *Heparin*



130. *Mannose*
131. *Fructose*
132. *Glucose*
133. *Galactose*



Answer Key

MCQ:

1	2	3	4	5	6	7	8	9	10
D	C	B	B	A	A	B	B	C	D
11	12	13	14	15	16	17	18	19	20
C	C	C	A	B	C	B	A	A	D
21	22	23	24	25	26	27	28	29	30
E	D	D	E	A	C	B	D	D	A
31	32	33	34	35	36	37	38	39	40
A	B	E	B	A	E	B	A	C	C
41									
C									

True and false:

42	43	44	45	46	47	48	49	50	51
T	T	F	T	T	F	F	T	T	F
52	53	54	55	56	57	58	59	60	61
T	F	T	T	F	T	T	T	F	T
62	63	64	65	66	67	68	69	70	71
T	T	T	F	F	F	F	F	T	F
72	73	74	75	76	77	78	79	80	81
T	F	F	T	T	T	F	T	F	T
82	83	84	85	86					
T	F	T	F	F					

Matching:

87	88	89	90	91	92	93	94	95	96
D	A	E	B	G	C	B	D	C	B
97	98	99	100	101	102	103	104	105	106
D	B	C	E	A	D	B	A	C	E
107	108	109	110	111	112	113	114	115	116
B	D	A	E	C	C	D	A	B	C
117	118	119	120	121	122	123	124	125	126
B	D	A	D	A	C	E	B	E	D
127	128	129	130	131	132	133			
B	A	C	B	D	A	C			

Chapter 2 — *Lipids Chemistry, Free Radicals and Anti-oxidants*

1. *What are lipids?*
   A. Lipids are a heterogeneous group of compounds related to fatty acids. Many of them are esters of fatty acids and alcohol.
2. *Are lipids hydrophilic or hydrophobic?*
   A. Lipids are hydrophobic, because they are insoluble in water and soluble in fat solvents (as benzene and ether).
3. *How lipids are classified?*
   A. Simple, compound and derived.
4. *What are simple lipids:*
   A. Esters of fatty acids with various alcohols e.g. triacylglycerols.
5. *What are compound lipids:*
   A. Ester of fatty acids with alcohol and conjugated to other group e.g. phospholipids.
6. *What are derived lipids:*
   A. They are substances derived from simple and compound lipids by hydrolysis as fatty acids and glycerol. They include also other substances that are insoluble in water but soluble in fat solvents as cholesterol and ketone bodies.
7. *Classify fatty acids.*
   A. Depending on the total number of carbon atoms, they are classified as even chain and odd chain.
8. *Which type is prevalent in human body?*
   A. Even chain fatty acids.
9. *Are fatty acids classified in any other way?*
   A. They are also classified as saturated or unsaturated, linear or branched fatty acids.
10. *What fatty acids are generally present in human fat?*
    A. Mainly Oleic acid, then comes palmitic acid and linoleic acid.

11. *How many carbon atoms are present in oleic acid?*

A. 18 carbon, with one double bond.

12. Name some unsaturated fatty acids.

A. Oleic, linoleic, linolenic and arachidonic acids.

13. *Name some polyunsaturated fatty acids.*

A. Linoleic, linolenic and arachidonic acids.

14. *What do you mean by polyunsaturated fatty acids (PUFA)?*

A. Fatty acids having more than one double bond.

15. *Define essential fatty acids.*

A. These are polyunsaturated fatty acids that cannot be synthesized in the body. They must be obtained in the diet e.g. lenoleic, lenolenic and arachidonic acids.

16. *What are the functions of essential fatty acids?*

A. Normal growth, and synthesis of phospholipids, cholesterol ester, and eicosanoids.

17. *What is the relationship between essential fatty acids and phospholipids?*

A. Essential fatty acids enter in the structure of phospholipids mainly in the 2^{nd} position of glycerol.

18. *What is the importance of cholesterol ester with essential fatty acids?*

A. Cholesterol esterified with essential fatty acids is rapidly metabolized by the liver. This prevents precipitation of free cholesterol along the endothelium of blood vessels and prevents atherosclerosis.

19. *What are the eicosanoids precursors?*

A. Mainly arachidonic acid.

20. *What are types of eicosanoids:*

A. They comprise the prostanoids, leukotrienes (LTs) and lipoxins (LXs). Prostanoids include prostaglandins (PGs), prostacyclins (PGIs) and thromboxane TXs).

21. *What are the functions of eicosanoids:*

A. Prostacyclin (PGI_2) inhibits aggregation of platelets. Thromboxane A_2 (TXA_2) stimulates aggregation of platelets. Leukotriene A_4 (LTA) acts as mediator of allergic reactions and inflammation.

22. *What is the structure of linoleic acid?*

A. 18 carbon, with two double bonds.

23. *What is the structure of linolenic acid?*

A. 18 carbon with three double bonds.

24. *What is the structure of arachidonic acid?*

A. 20 carbon with four double bonds.

25. *Which contains good quantity of PUFA?*

A. Vegetable oils such as sunflower oil, linseed oil and corn oil.

26. *Which contains very low level of PUFA?*

A. Coconut oil and animal fats.

27. *What is meant by hardening (hydrogenation) of oils?*

A. This is a saturation of unsaturated fatty acids present in liquid oils converting them into solid (margarine).

28. *What are conditions that favor hardening of oils?*

A. This is usually manufactures at high temperature and in the presence of nickel as a catalyst.

29. *What is meant by drying oils?*

A. A drying oil is an oil that when spread in a thin layer, is oxidized and changed to dry and hard film. This is a type of oxidation by atmospheric oxygen.

30. *What is meant by volatile fatty acids?*

A. They are short chain fatty acids (contain from 2-6 carbon atoms), which can be distilled by steam.

31. *What is the advantage of storing energy as triacylglycerols in the body?*

A. Space requirement is less, storage does not require water, can be mobilized whenever required, capacity for storage is unlimited.

32. *Give an account on alkali hydrolysis of neutral fat.*

A. It produces saponification fraction (soaps), which is sodium and potassium salt of fatty acids, and nonsaponification fraction that is not affected by alkali hydrolysis.

33. *What is saponification?*

A. Hydrolysis of fat by alkali.

34. *What is saponification number (value):*

A. This is the number of mg of KOH necessary to saponify (=combined) all fatty acids present in one gram of fat.

35. *Does saponification number of a fat molecule increase or decrease with the presence of short chain fatty acids?*

A. Fats, which possess a high percentage of short chain fatty acids, have a greater saponification number than that possess high percentage of long chain fatty acids.

36. *What is iodine number (value)*

A. This is the number of grams of iodine necessary to saturate all unsaturated fatty acids present in 100 grams of fat.

37. *What is the significance of iodine number?*

A. It gives an idea about the degree of unsaturation of the fatty acids present in fat.

38. *What is acid number(value):*

A. This is the number of mg of KOH necessary to neutralize the free fatty acids present in one gram of fat.

39. *What is the significance of acid number?*

A. It is important for detection of rancidity. Normally the acid number is zero. After rancidity, free fatty acids are produced in excess.

40. *What is acetyl number (value):*

A. This is the number of mg of KOH necessary to neutralize the acetic acid of one gram of acetylated fat.

41. *What is the significance of acetyl number?*

A. Acetyl value is used to detect the presence of hydroxy fatty acids.

42. *What is the test for degree of fatty acid unsaturation?*

A. Iodine number.

43. *What is the test for the percentage of short chain fatty acids in fat?*

A. Saponification number.

44. *What is rancidity?*

A. It is a toxic reaction of triacylglycerols by partial oxidation of fatty acids. It leads to unpleasant odor and taste of oils and fats.

45. *What are the causes of unpleasant odor and taste of rancid oil?*

A. Partial oxidation of fatty acids by oxygen of the air, bacteria or moisture, with formation of epoxides and peroxides of small molecular weight fatty acids.

46. *Enumerate enhancers of rancidity*

A. lead, copper, heme compounds and lipooxygenase enzyme present in platelets.

47. *How can rancidity be prevented?*

A. By antioxidants as vitamins E, A and C and substances containing –SH group as cysteine amino acid.

48. *What are phospholipids?*

A. These are lipids conjugated with phosphate.

49. *Give examples of phospholipids.*

A. Lecithin, plasmalogen, sphingomyelin, cephaline, lysolecithin, cardiolipin, phosphatidylinositol and phosphatidylserine.

50. *What are phospholipids containing choline?*

A. Lecithin, plasmalogen and sphingomyelin.

51. *What is lecithin?*

A. Phosphatidyl choline.

52. *What is the nitrogenous base present in lecithin?*

A. Choline.

53. *What are the hydrolytic products of lecithin?*

A. Glycerol + Saturated fatty acid + Unsaturated fatty acid + Phosphate + Choline.

54. *What are the functions of dipalmityl lecithin?*

A. Lungs surfactant.

55. *What is lung surfactant?*

A. Dipalmitoyl lecithin is continuously secreted by the alveolar epithelial cells in the lungs, forming a monolayer over the watery surface of the alveolus. This lowers the surface tension and helps expiration and inspiration. During expiration, the surfactant becomes solid under pressure. This prevents the adherence of the alveolar wall. During inspiration, the surfactant makes the lung easier to expand.

56. *What are the constituents of surfactants?*

A. Surfactants contain mainly dipalmitoyl lecithin. In addition. They contain cholesterol and surfactant proteins A, B and C.

57. *What is the clinical significance of low levels of surfactants?*

A. Low levels of surfactant lead to respiratory distress syndrome (RDS), which is a common cause of neonatal morbidity.

58. *Why premature babies may suffer from respiratory distress syndrome?*

A. Due to deficiency of lung surfactants.

59. *What are sphingolipids?*

A. All sphingolipids have the long aliphatic amino alcohol sphingosine, which is attached to a fatty acid in amide linkage to form a ceramide. They include phosphosphingoside and glycosphingolipids.

60. *What is sphingomyelin?*

A. It is phosphosphingoside.

61. *On hydrolysis of sphingomyelin, what are obtained?*

A. Sphingosine + Fatty acid + Phosphate + Choline

62. *What is phosphatidic acid?*

A. Glycerol + two fatty acid residues are esterified to carbon atoms 1 and 2 + phosphoric acid.

63. *What is Cephalin?*

A. Phosphatidyl ethanolamine.

64. *What is cardiolipin?*

A. Diphosphatidyl glycerol.

65. *What are the hydrolytic products of cephalin?*

A. Glycerol + Saturated fatty acid + Unsaturated fatty acid + Phosphate + Ethanolamine.

66. *What are the hydrolytic products of plasmalogen?*

A. Glycerol + Unsaturated alcohol + Fatty acid + Phosphate + Choline

67. *What are the hydrolytic products of cardiolipin?*

A. 2 units of phosphatidic acid united together by glycerol. Each phosphatidic acid is composed of: Glycerol + Saturated fatty acid + Unsaturated fatty acid + Phosphate.

68. *What are the hydrolytic products of phosphatidyl serine?*

A. Glycerol + Saturated fatty acid + Unsaturated fatty acid + Phosphate + Serine.

69. *What are the hydrolytic products of phosphatidyl inositol?*

A. Glycerol + Saturated fatty acid + Unsaturated fatty acid + Phosphate + Inositol.

70. *What is the significance of phosphatidyl inositol?*

A. It is a precursor of inositol triphosphate, which acts as 2^{nd} messenger for hormonal action.

71. *What are phospholipids containing glycerol?*

A. Lecithin, plasmalogen, cephalin , lysolecithin, cardiolipin, phosphatidyl inositol and phosphatidyl serine.

72. *What are the functions of phospholipids?*

A. Phospholipids are constituents of cell membrane. Phospholipids act as neurotransmitters, methyl donors (e.g. lecithin), lung surfactant (dipalmityl lecithin), lipotropic factors, blood coagulation (cephalin) and 2^{nd} messenger for hormonal action (phosphatidyl inositol). Phospholipids in bile make cholesterol soluble. Their deficiency leads to cholesterol gallstones.

73. Phospholipids can aggregate into what?

A. Micelle and liposome.

74. What are lipids containg sphingosine?.

A. Sphingomyelin, kerasin, nervone, cerebron and ganglioside.

75. What are glycolipids?

A. Cerebrosides (kerasin, nervone, cerebron) and gangliosides.

76. What are cerbrosides?

A. Kerasin, nervone, and cerebron.

77. Cerebroside contains what?

A. Sphingosine,fatty acid, and hexose.

78. What are the hydrolytic products of kerasin?

A. Sphingosine + Lignoceric acid + Galactose.

79. What are the hydrolytic products of cerebron?

A. Sphingosine + Cerebronic acid + Galactose.

80. What are the hydrolytic products of nervon?

A. Sphingosine + Nervonic acid + Galactose.

81. What are the hydrolytic products of gangliosides?

A. Sphingosine + Fatty acid + 3 molecules of hexoses (galactose or glucose) + Hexosamine + Sialic acid.

82. Name some lipid storage diseases.

A. Tay Sach's disease, Niemann Pick's disease, Gaucher's disease.

83. What are the functions of cholesterol?

A. Cholesterol is a constituent of cell membrane. Cholesterol is also the precursor of vitamin D_3, steroid hormones and bile acids.

84. What are steroid hormones?

A. Female sex hormones, male sex hormones, glucocorticoids and mineralocorticoids.

85. What are female sex steroid hormones?

A. Progesterone and oestrogens (E1, E2 and E3).

86. What are male sex steroid hormones?

A. Testosterone and other androgens.

87. Enumerate substances possessing steroid nucleus.

A. Cholesterol, vitamin D group, female sex hormones (progesterone and estrogens [E1, E2 and E3]), male sex hormones (testosterone and other androgens) glucocorticoids and mineralocorticoids.

88. *What are the functions of testetosterone?*

A. It stimulates the development of male sex characters and organs. It stimulates sperms formation (spermatogenesis). They have anabolic effect on proteins.

89. *What are functions of estrogens?*

A. They stimulate the development of female secondary sex characters and organs e.g. voice, distribution of hair, distribution of fat. They stimulate the development of female sex organs e.g. uterus. E_2 has anabolic effects on bone and cartilages.

90. *What are functions of progesterone?*

A. It prepares the uterus for implantation of the ovum. It stabilizes pregnancy. It prepares the uterus for implantation of the ovum. It stabilizes pregnancy (it prevents abortion). It stimulates breast acini during puberty and pregnancy. It inhibits milk production in late pregnancy. Progesterone antagonizes the action of estrogens at various tissues.

91. *What are functions of mineralocorticoids?*

A. They control the metabolism of water and minerals (sodium, potassium, etc).

92. *What are the functions of cortisol?*

A. Cortisol is one of glucocorticoids that control the metabolism of carbohydrate, protein and lipids.

93. *What do you mean by amphipathic lipids?*

A. Amphipathic molecules are those, which are formed of 2 parts; water soluble and water insoluble. phospholipids and glycolipids are amphipathic.

94. *Why phospholipids are amphipathic?*

A. Phospholipids possess both polar groups (glycerol, phosphate and nitrogen bases) and nonpolar group (hydrocarbon chains of fatty acids). They are arranged in 2 layers in cell membranes (lipid bilayers) so that the nonpolar groups are towards each other and polar groups are towards outside. This facilitates the transport of different substances across membranes.

95. *Name the free radicals.*

A. superoxide anion radical, hydroperoxyl radical, hydrogen peroxide, hydroxyl radical, lipid peroxide radical, nitric oxide, and peroxy nitrite.

96. *What are the important characteristics of reactive oxygen species (ROS)?*

A. Extreme reactivity, short life span, generation of new ROS by chain reaction, and damage to various tissues.

97. *What are the enzymes generating ROS in macrophages?*

A. NADPH oxidase, superoxide dismutase, and myeloperoxidase.

98. *What are the biological effects of ROS?*

A. Protein damage, loss of function, lipid peroxidation, membrane damage, mitochondrial damage, DNA damage, cell death, mutation, and cancer.

99. *What are the free radical scavinging enzymes?*

A. Superoxide dismutase, glutathione peroxidase, glutathione reductase, and catalase.

100. *ROS causes what diseases?*

A. Chronic inflammation, rheumatoid arthritis, acute inflammations, bronchopulmonary dysplasia, respiratory distress syndrome, cataract, atherosclerosis, and peptic ulcer.

101. *Name important anti-oxidants.*

A. Alpha tocopherol (Vitamin E), Vitamin C, Vitamin A, and beta carotene.

102. *What are micelles?*

A. These are combination of bile salts with dietary lipids to form spheres of polar lipids outside and nonpolar lipids inside. These are important for absorption of lipids.

103. *What are functions of lipids?*

A. Dietary lipids make diet more palatable, produce Energy, supply fat soluble vitamins (A, D, E and K). Subcutaneous fat helps in keeping body temperature constant. Lipoproteins are important for transport of lipids in blood. Phospholipids and cholesterol enter in the structure of every body cell. Lipids include essential fatty acids and steroid hormones.

104. *Compare between oil and solid fat.*

	Oils	Solid Fats
Melting point	At room temperature; they are liquids	At room temperature; they are solids.
Sources	Plants	Animals
Structure	Rich in unsaturated fatty acids	Rich in saturated fatty acids
Saponification number	High	Low

105. *Compare between triacylglycerols and waxes.*

	Triacylglycerols	Waxes
Composition	Glycerol + 3 Fatty acids	Fatty acids + Higher alcohols
Melting point	At room temperature; they are either solids or liquids	At room temperature; they are solids.
Rancidity	They may undergo rancidity	They do not undergo rancidity
Acrolein test	Positive	Negative

MCQ, Matching, True and False Completion

Select and encircle the most appropriate answer or completion:

1. *The fatty acid essential for life in man is:*
   A. Butyric acid
   B. Palmitic acid
   C. Stearic acid
   D. Oleic acid
   E. Linolenic acid

2. *Which of the following is NOT a constituent of gangliosides:*
   A. Glycerol
   B. Sialic acid
   C. Hexose sugar
   D. Sphingosine
   E. Long chain fatty acid

3. *The process of hydrolysis of triacylglycerols by an alkali is:*
   A. Esterification
   B. Reduction
   C. Saponification
   D. Oxidation
   E. Hydrolysis

4. *A substance NOT steroid in nature is:*
   A. Testosterone
   B. Ergosterol
   C. Progesterone
   D. Prostaglandin

5. *Stearic acid is:*
   A. Essential fatty acid
   B. Short chain fatty acid
   C. Unsaturated fatty acid
   D. Possessing 18 carbon atoms

6. *Addition of choline to phosphotidic acid produces:*
   A. Lysolecithin
   B. Phosphatidyl serine
   C. Plasmalogen
   D. Lecithin

7. *Hydrolysis of sphingomyelin produces all the following EXCEPT::*
   A. One fatty acid
   B. Serine
   C. Sphingosine
   D. Phosphate
   E. Choline

8. *Phospholipids:*
   A. Always contain choline and glycerol.
   B. An important source of energy during fasting.
   C. Are a major component of membranes.
   D. Are the main lipid conten of VLDL.

9. *The following are essential fatty acids in man EXCEPT :*
   A. Oleic
   B. Lenoleic
   C. Lenolenic
   D. Arachidonic

10. *Which of the following is a polyunsaturated fatty acid:*
   A. Oliec
   B. Lenoleic
   C. nervonic
   D. Palmitic
   E. Palmitoleic

11. *All the following are essential fatty acids in man EXCEPT:*
   A. Oliec
   B. Lenoleic
   C. Lenolenic
   D. Arachidonic
   E. Clupadonic

12. *Rancidity is defined as:*
   A. hydrogenation of unsaturated fatty acids
   B. hydrolysis of triacylglycerols by alkali
   C. Synthesis of triacylglycerols
   D. Toxic reactions of triacylglycerols
   E. Hydroxylation of fatty acids

13. *The precursor of all steroid is:*
   A. Progesterone
   B. Testosterone
   C. Cholesterol
   D. Calcitriol
   E. Cholic acid

14. *Which fatty acid is NOT unsaturated?*
   A. Oleic acid
   B. Lenoleic acid
   C. Palmitoleic acid
   D. Stearic acid
   E. Arachidonic acid.

15. *The following are sphingosine containing lipids EXCEPT:*
   A. Plasmalogen
   B. Kerasin
   C. Nervon
   D. Ganglioside
   E. Sphingomyelin

16. *Which of the following is lungs surfactant?*
   A. Dipamlmityl cephalin
   B. Dipalmityl lecithin
   C. Plasmalogen
   D. Cardiolipin
   E. Ceramide

17. *Which of the following is NOT a phospholipid?*
   A. Cerebroside
   B. Plasmalogen
   C. Sphingomyelin
   D. Cephalin
   E. Lecithin

18. *Number of mg of KOH necessary to neutralize the free fatty acids present in one gram of fat is:*
   A. Acetyl value.
   B. Iodine value
   C. Saponification value.
   D. Acid value.
   E. Non of the above.

19. *Amphipathic lipids are formed of:*
   A. Nonpolar lipids.
   B. Polar lipids.
   C. Polar and nonpolar lipids.
   D. Neutral fat.
   E. Waxes.

20. *Hydrolysis of lecithin yields the following products EXCEPT:*
   A. Saturated fatty acid
   B. Choline
   C. Glycerol
   D. Phosphate
   E. Ethanolamine

21. *The test of unsaturation of fatty acid is:*
   A. Saponification number
   B. Acid number
   C. Iodine number
   D. Acetyl number

22. *All of the following phospholipids contain choline EXCEPT:*
   A. Lecithin
   B. Cephalin
   C. Plasmalogen
   D. Sphingomyelin

23. *Hydrogenation of oleic acid produces:*
   A. Lenoleic acid
   B. Lenolenic acid
   C. Stearic acid
   D. Palmitic acid
   E. Arachidonic acid

24. *The following conjugated lipids contain glycerol EXCEPT:*
   A. Lecithin
   B. Cephalin
   C. Plasmalogen
   D. Cardiolipin
   E. Cerebroside

25. *Antioxidant is a substance that:*
   A. Produces rancidity
   B. Prevents rancidity
   C. Produces Hardening of oils
   D. Produces emulsification of oils

26. *Which of the following is NOT steroid?*
   A. Vitamin D_3
   B. Testosterone
   C. Cholesterol
   D. Prostacyclin
   E. Progesterone

27. *The following are plasma lipoproteins EXCEPT:*
   A. Chylomicrons
   B. Very low density lipoproteins (VLDL)
   C. Low density lipoproteins (LDL)
   D. Very high density lipoproteins (VHDL)
   E. High density lipoproteins (HDL)

28. *An unsaturated fatty acid with 4 double bonds is:*
   A. Oleic
   B. Palmitolic
   C. Lenoleic
   D. Lenolenic
   E. Arachidonic

29. *The phospholipid cardiolipin is found almost exclusively in:*
   A. Mitochondrial membrane
   B. Plasma membrane
   C. Lysosomal membrane
   D. Smooth endoplasmic reticular membrane
   E. Rough endoplasmic reticular membrane

30. *A second messenger for hormonal action is derived from:*
   A. Phosphatidyl choline
   B. Phosphatidyl serine
   C. Phosphatidyl ethanolamine
   D. Phosphatidyl inositol
   E. Dipalmityl lecithin

In the following questions indicate with clear (T) the true statements, and with clear (F) the false statements:

Rancidity:

31. Has only one type, which is oxidative rancidity.
32. Is the formation of peroxides and epioxides of fatty acids
33. Can be prevented by vitamin E.
34. Results from exposure of fat to oxygen, bacteria or moisture.
35. Is enhanced by vitamin C.

Fatty acids:

36. Are mostly aliphatic in human.
37. Are all insoluble in water.
38. In human, are not required at all in diet.
39. All must be supplied by the diet.
40. Their last –CH3 is the ω carbon.

Lipids are:

41. *Source of energy for some body cells*
42. *Poorly soluble in water*
43. *Structural components of cell membranes*
44. *Composed of only carbon, hydrogen and oxygen*
45. *Needs bile salts for absorption*

Cholesterol:

46. Is a simple lipid.
47. Is the precursor of all steroid hormones
48. In liver it may be converted into bile acids
49. Is the precursor of vitamin D2.
50. Enters in the structure of every body cell

Triacylglycerols:

51. Reacts with alkalies to form soap
52. Are stored mainly in the body in the liver
53. Their specific gravity less than one
54. Give negative acrolein test
55. Can be hydrolyzed by pancreatic lipase enzyme

Lecithin:

56. Is a glycolipid
57. Acts as a body store of choline
58. Upon hydrolysis, it gives sphingosine base, saturated fatty acid, unsaturated fatty acid, phosphate and choline
59. Dipalmityl lecithin acts as a surfactant in the lung
60. Acts as an activator factor in coagulation mechanism

Essential fatty acids:

61. Are those that can be formed by the body
62. Are polyunsaturated fatty acids
63. Are important for normal growth
64. Are rich in triacylglycerols of animal origin as butter and lards
65. Include arachidonic acid (20 carbons) which is a precursor of eicosanoids

For lipids:

66. Cholesterol is a plant sterol having double bonds.

67. Phosphocholine is present in lecithin and plasmalogen.

68. Lenoleic acid is an essential fatty acid with 4 double bonds.

69. Dipalmitoyl lecithin acts as a lung surfactant which prevents respiratory distress syndrome.

70. Phospholipids act as structural component of cell membranes.

71. Prostaglandins are derived from arachidonic acid.

Matching: *For each set of numbered questions, choose the ONE BEST answer from the list of lettered options below it. An answer may be used once or more times, or not at all.*

Match the numbered items and the lettered structure in the figure beside as they best fit together:

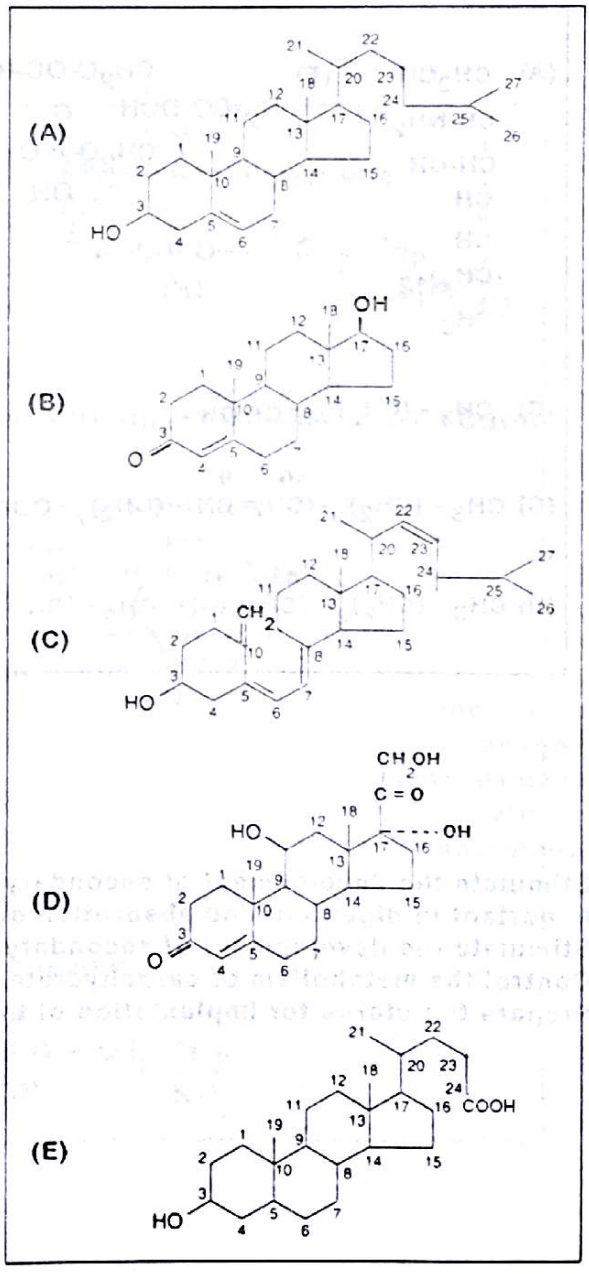
72. *Vitamin D3*

73. *Lithocholic acid*

74. *Cortisol*

75. *Testosterone*

76. *Cholesterol*

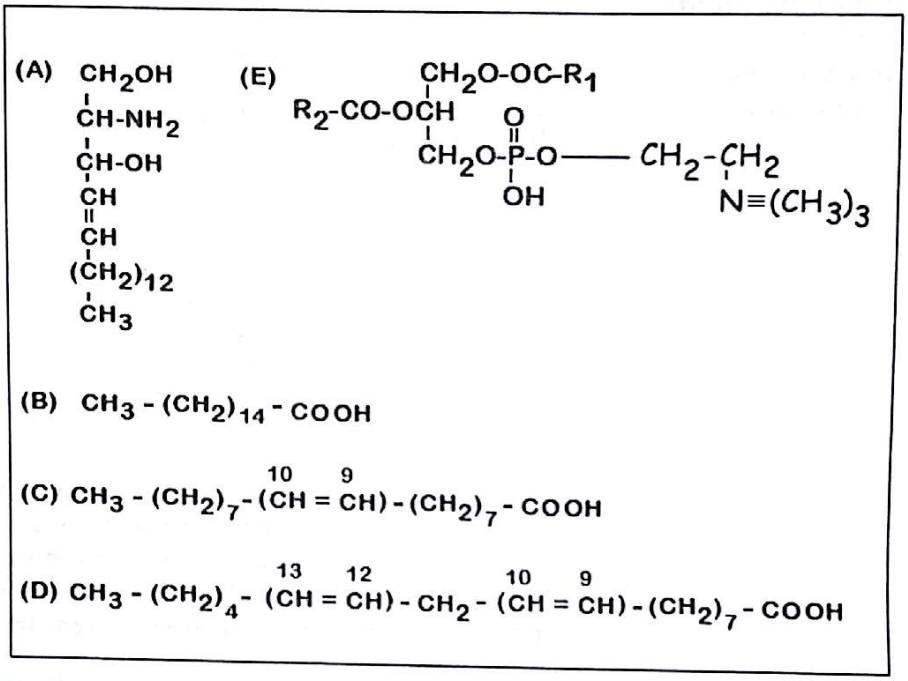


77. *Dipalmityl lecithin .*
78. *Waxes*
79. *Cholesterol*
80. *Oleic acid*
81. *Eicosanoids*

A. Derived from arachidonic acid.
B. Esters of fatty acids and alcohol other than glycerol.
C. Surfactant in the lung.
D. An alcohol of animal origin.
E. Unsaturated fatty acid has one double bond.

Match the numbered items and the lettered structure in the figure beside as they best fit together:

82. *Palmatic acid*
83. *Linoleic acid*
84. *Oleic acid*
85. *Sphingosine*
86. *Lecithin*



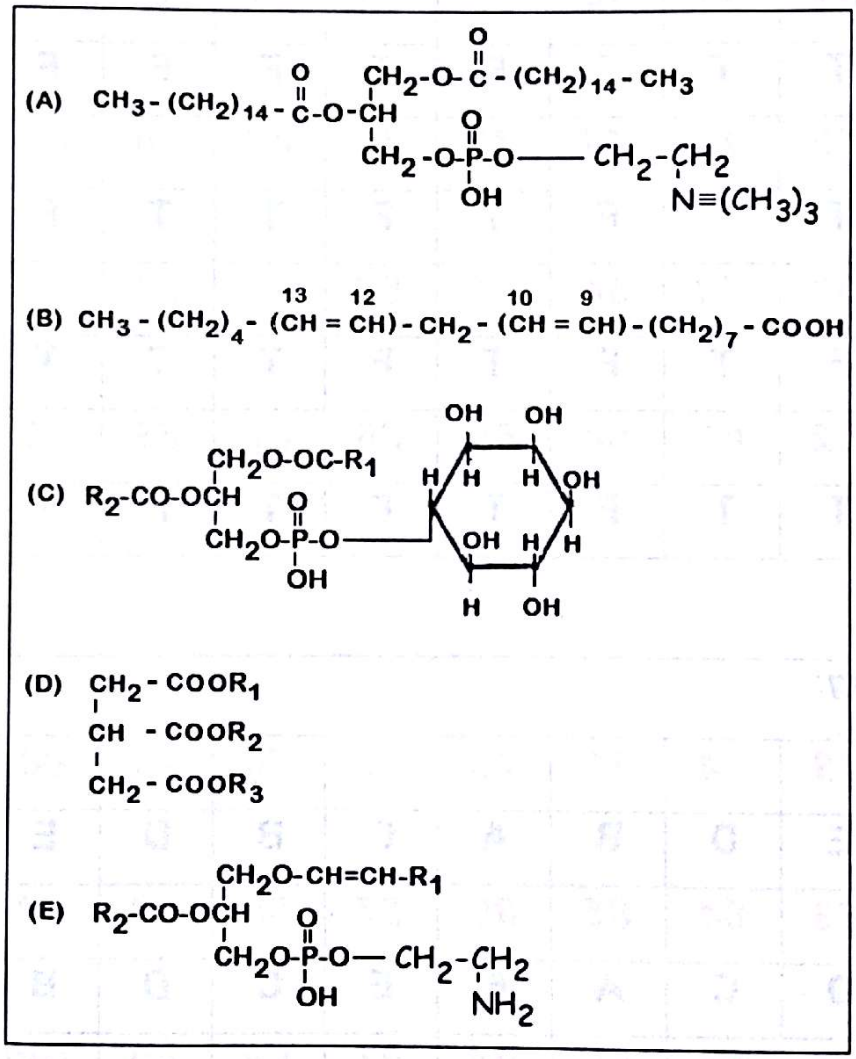
87. *Progesterone*
88. *Estrogens*
89. *Glucocorticoids*
90. *Bile salts*
91. *Testosterone*

A. Stimulate the development of secondary male sex characters.
B. Important in digestion and absorption of lipids.
C. Stimulate the development of secondary female sex characters.
D. Control the metabolism of carbohydrate, lipids and proteins.
E. Prepare the uterus for implantation of the fertilized ovum.

92. *Chylomicrones*
93. *VLDL*
94. *LDL*
95. *HDL*
96. *Free fatty acids- Albumin complex*
    A. Synthesized in the kidney
    B. Contain 99% protein
    C. Contain apolipoproteins B_{48}
    D. Equivalent to pre β-Lipoproteins
    E. Transport cholesterol from peripheral tissues to liver
    F. Derived from circulating IDL

Match the numbered items and the lettered structure in the figure beside as they best fit together:

97. *Triacylglycerol*
98. *Plasmalogen*
99. *Lipositol*
100. *Dipalmitoyl lecithin*
101. *Linoleic acid*



Answer Key

MCQ:

1	2	3	4	5	6	7	8	9	10
E	A	C	D	D	D	B	C	A	B
11	12	13	14	15	16	17	18	19	20
A	D	C	D	A	B	A	D	C	E
21	22	23	24	25	26	27	28	29	30
C	B	C	E	B	D	D	E	A	D

True and false:

31	32	33	34	35	36	37	38	39	40
F	T	T	T	F	T	F	F	F	T
41	42	43	44	45	46	47	48	49	50
T	T	T	F	T	F	T	T	F	T
51	52	53	54	55	56	57	58	59	60
T	F	T	F	T	F	T	T	T	F
61	62	63	64	65	66	67	68	69	70
F	T	T	F	T	F	T	F	T	T
71									
T									

Matching:

72	73	74	75	76	77	78	79	80	81
C	E	D	B	A	C	B	D	E	A
82	83	84	85	86	87	88	89	90	91
B	D	C	A	E	E	C	D	B	A
92	93	94	95	96	97	98	99	100	101
C	D	F	E	B	D	E	C	A	B

Chapter 3 Amino Acids, Peptides And Proteins

1. *How can amino acids be classified?*

   A. Chemical, nutritional and metabolic classifications.

2. *How do you classify amino acids by chemical methods?*

   A. Based on *the structure,* amino acids are classified into: simple amino acids, branched chain amino acids, hydroxy amino acids, sulfur containing amino acids, amino acids with amide group, acidic amino acids, basic amino acids, aromatic amino acids, heterocyclic amino acids, imino acid and derived amino acids.

3. *What are branched chain amino acids?*

   A. Valine, leucine and isoleucine.

4. *What are hydroxy amino acids?*

   A. Serine and threonine. and tyrosine

5. *Name the sulfur containing amino acids.*

   A. Cysteine, cystine and methionine.

6. *Name the acidic amino acids.*

   A. Aspartic acid and glutamic acid.

7. *What are the basic amino acids?*

   A. Lysine, arginine, ornithin, and histidine.

8. *Which amino acid has a net positive charge at physiological pH?*

   A. Arginine and lysine.

9. *Name amino acid containing a thio-ether bond:*

   A. Methionine.

10. *Give examples of amino acids with hydrophobic side chains.*

    A. Valine, leucine, isoleucine.

11. *Give the names of aromatic amino acids.*

    A. Phenylalanine and tyrosine.

12. *What are heterocyclic amino acids?*

    A. Tryptophan, histidine, proline and hydroxy proline.

13. *Give an example of an imino acid.*

    A. Proline.

14. *Give examples of derived amino acids.*

A. Hydroxy proline, hydroxy lysine, ornithine, citrulline, and homocysteine.

15. *Benzene group is present in which amino acid?*

A. Phenyl alanine.

16. *Phenol group is present in which amino acid?*

A. Tyrosine.

17. *Tryptophan contains what special group?*

A. Indole group.

18. *Which special group is present in histidine?*

A. Imidazole group.

19. *Which special group is present in arginine?*

A. guanido group.

20. *Which special group is present in citruline?*

A. Ureido group.

21. *Pyrrolidine group is present in which amino acid?*

A. Proline and hydroxyproline (imino acids).

22. *Hydrophobic bonds are formed in protein between which amino acids?*

A. Valine, leucine and isoleucine residues.

23. *How do you classify amino acids into ketogenic and glucogenic?*

A. Ketogenic amino acids enter into the metabolic pathway of fats, while glucogenic amino acids enter the pathway of glucose metabolism.

24. *Name a purely ketogenic amino acid.*

A. Leucine.

25. *Name some glucogenic amino acids.*

A. Glycine, serine and aspartic acid.

26. *Which amino acids are synthesized after it gets incorporated* تتحد / تندمج *into proteins?*

A. Hydroxypyroline and hydroxylysine.

27. *What are the essential amino acids?*

A. Those cannot be synthesized in the body; and so, must be provided in the diet.

28. *How many amino acids are essential?*

A. Eight amino acids are essential; two are semi-essential and the rest 10 are non-essential.

29. *Are non-essential amino acids necessary for the body?*

A. Yes, they are also necessary for protein synthesis, but they can be synthesized by the body.

30. *Name the essential amino acids.*

A. Isoleucine, lysine, tryptophan, methionine, valine, phenylalanine, leucine and threonine.

31. *Name the semi-essential amino acids.*

A. Histidine and arginine.

32. *Why are they called semi-essential?*

A. Because they are formed in the body in amount enough for adults, but not for growing children.

33. *Is phenylalanine an essential amino acid?*

A. Yes.

34. *What about tyrosine?*

A. Tyrosine is non-essential because it is synthesized in the body from phenylalanine.

35. *When does tyrosine become essential?*

A. In case of deficiency (نقص) of phenylalanine hydroxylase that converts phenylalanine into tyrosine.

36. *What are amino acids derived from acetic acid (2 carbons)?*

A. Glycine.

37. *What are amino acids derived from propionic acid (3 carbons)?*

A. Alanine, phenylalanine, tyrosine, serine, cysteine, tryptophan and histidine.

38. *What are amino acids derived from butyric acid (4 carbons)?*

A. Threonine and methionine.

39. *What are amino acids derived from valeric acid (5 carbons)?*

A. Isoleucine and Arginine.

40. *What are amino acids derived from isovaleric acid (branched 5 carbons)?*

A. Valine.

41. *What are amino acids derived from caproic acid (6 carbons)?*

A. Lysine.

42. *What are amino acids derived from isocaproic acid (branched 6 carbons)?*

A. Leucine.

43. *What are polar and non polar amino acids?*

A. Non-polar are glycine, alanine, phenylalanine, tryptophan, methionine, valine, leucine, isoleucine and proline. Polar are the rest of amino acids.

44. *What are non α amino acids?*

A. β-alanine, γ amino butyric acid and taurine.

45. *What is zwitter ion?*

A. This is a molecule (amino acid) that carries an equal number of both positive and negative charges i.e. carry no net charge.

46. *What is iso-electric point (pH) of the amino acids?*

A. It is the pH at which the amino acids carry no net charge. The zwitter ions are formed at such pH.

47. *What are the characteristic features of iso-electric pH?*

A. At iso-electric point the amino acid carries no net charge, there is no mobility in electrical field, solubility will be minimum, the tendency for precipitation will be maximum. ← قابلية

48. *What is the speciality of Histidine?* الترسيب

A. The pK value of Histidine is 6.1, and therefore effective as a buffer at the physiological pH of 7.4. The buffering capacity of plasma proteins and hemoglobin is mainly due to histidine residue.

49. *Which is the amino acid having maximum buffering capacity at physiological pH?*

A. Histidine.

50. *Which amino acid is optically inactive?*

A. Glycine.

51. *Why?*

A. Because glycine is the only amino acid that contains no asymmetric amino acid.

52. *What are the isomers of amino acids?*

A. D and L carbon atoms.

53. *Which isomer of amino acids is the character of body proteins?*

A. L-amino acids.

54. *Can you name some substances where D-amino acids are seen?*

A. D-amino acids are seen in cell walls of microorganisms and as constituents of certain antibiotics such as polymyxin, actinomycine-D.

55. *What is meant by decarboxylation of an amino acid?*

A. The carboxyl group is removed from the amino acids to form the corresponding amine.

56. *Give examples of decarboxylation reactions.*

A. Histidine to histamine; tyrosine to tyramine; and tryptophan to tryptamine.

57. *What is produced when glutamic acid is decarboxylated?*

A. Gamma amino butyric acid (GABA).

58. *What is glutamine?*

A. It is the amide of glutamic acid.

59. *What is the significance of -SH groups in proteins?*

A. The -SH group of cysteine can form a disulfide (S-S) bond with another cysteine residue. The two cysteine residues can connect two polypeptide chains by the formation of inter-chain disulfide bonds.

60. *Glutathione is made up of which amino acids?*

A. Glutamic acid, cysteine and glycine.

61. *Phosphorylation is taking place on which amino acid residues?*

A. Serine and threonine.

62. *What is ninhydrin reaction?*

A. All amino acids when heated with ninhydrin will give blue color with liberation of ammonia and CO_2.

63. *What is the importance of ninhydrin reaction?*

A. It is used as qualitative test and quantitative estimation of amino acids. It is often used for detection of amino acids in chromatography.

64. *Do proteins give a color with ninhydrin?*

A. Proteins do not give a true color reaction; but N-terminal end amino group of protein will react with ninhydrin, to produce a blue color.

65. *What is fluorescamine reaction?*

A. Like ninhydrin, fluorescamine forms a blue complex with amino acids.

66. *What is the basis of xanthoproteic test?*

A. The phenyl groups in phenylalanine, and tyrosine reacts with the reagents to give orange color.

67. *What is the basis of Rosenheim`s test?*

A. The indole group in tryptophan reacts with the reagents to give purple color.

68. *What is the basis of Millon test?*

A. The phenol group in tyrosine reacts with the reagents to give red color.

69. *What are the functions of amino acids?*

A. They enter in the structure of body peptides, proteins (plasma proteins & tissue proteins), enzymes, hormones (thyroxin and

catecholaminse), amines (histamine). Some of them act as neurotransmitters or used in detoxication.

70. *What is the difference between a polypeptide and a protein?*

A. Chains containing less than 50 amino acids are called polypeptide. Chains containing more than 50 amino acids are called proteins.

71. *What is a dipeptide?*

A. Two amino acids are combined to form a dipeptide.

72. *How many peptide bonds are present in dipeptide?*

A. One.

73. *Enumerate some biologically active peptides?*

A. Hormones (insulin, vasopressin and oxytocin), β-lipotropin, bradykinin, antibiotics (valinomycin), aspartame, glutathione and natriuretic factor.

74. *What is a peptide bond?*

A. Alpha carboxyl group of one amino acid reacts with alpha amino group of another amino acid to form a peptide bond or CO-NH bridge.

75. *What are functions of glutathione?*

A. Defense mechanism against certain toxic compounds (as some drugs and مواد مسرطنة carcinogens), absorption and transport of amino acids, protection against cell damage and hemolysis of RBCs (by breaking down the hydrogen peroxide), activation of some enzymes and Inactivation of insulin hormone.

76. *What are functions of natriuretic factor?*

A. It stimulates the production of dilute urine (opposite to vasopressin).

77. *What are functions of β-lipotropin?*

A. Is the precursor of β-endorphin. β-Endorphin acts as neurotransmitter and neuromodulator. It has analgesic effect powerful 18-30 times than morphine.

78. *What are functions of bradykinin?*

A. It acts as a قوى potent smooth muscle relaxant and produces vasodilatation and hypotension.

79. *What are proteins?*

A. Proteins are macromolecules formed of amino acids united together by peptide bonds.

80. What are functions of body proteins?

A. Proteins enter in the structure of enzymes, hemoglobin, cell membranes, collagens, some hormones (e.g. insulin), cell

receptors, antibodies (immunoglobulins), keratin, coagulation factors, and ferritin. Proteins also act as carriers of some blood substances (e.g. lipids are transported as lipoproteins).

81. *What are the levels of protein structure?*

A. Proteins have primary, secondary, tertiary, and quaternary levels of structure.

82. *What is meant by primary structure of a protein?*

A. It means the number and sequence of amino acids in the protein.

83. *What are bonds responsible for primary protein structure?*

A. Peptide bond. It is a covalent bond. → رابطه تساهمية

84. *What is meant by secondary structure of a protein?*

A. It means spatial relationship (مكانية) between amino acid residues which are about 3-4 amino acids apart.

85. *What are bonds responsible for secondary protein structure?*

A. Hydrogen bonds.

86. *What are forms of secondary protein structure?*

A. α-helix and β-pleated sheets. → السمات البارزة

87. *What are the salient features of alpha helix of proteins?*

A. It is a right-handed spiral structure; each turn is formed by 3.6 amino acid residues; it is major structural form in globular proteins.

88. *What is meant by tertiary structure of a protein?*

A. The tertiary structure means three-dimensional structure of the whole protein. It defines the steric relationship of amino acids, which are far apart from each other in the linear sequence. تسلسل خطي

89. *What are bonds responsible for tertiary protein structure?*

A. Hydrogen bonds (within the chain or between chains), hydrophobic bonds (between the non-polar side chain of neutral amino acids), electrostatic bonds (between oppositely charged groups in the side chain of amino acids), disulfide bonds (between cysteine residues within the chain).

90. *What are forms of tertiary protein structure?*

A. Fibrous and globular.

91. *What is meant by quaternary structure of a proteins?*

A. Certain polypeptides will aggregate to form one functional protein. This is referred to as the quaternary structure.

92. *What are bonds responsible for quaternay structure of a protein?*

A. Hydrogen, electrostatic and hydrophobic bonds are possible bond for quaternary structure.

93. *Give some examples of proteins having quaternary structure.*

A. Hemoglobin, lactate dehydrogenase enzyme, and immunoglobulins.

94. *What are bonds responsible for protein structure?*

A. Protein structure is generally stabilized by 2 strong covalent bonds (peptide bond and disulfide bond) and 3 weak non-covalent bonds (hydrogen, hydrophilic and electrostatic bonds).

95. *What is the N-terminal and C-terminal ends of a protein?*

A. In a protein, at one end there will be one free α amino group. This end called the amino terminal (N-terminal) end. The other end of the polypeptide chain is called the carboxy terminal end (C-terminal) where there is a free α carboxyl group.

96. *What is mutation?*

A. Amino acid change in the linear sequence is called a mutation.

97. *Can you give an example?*

A. Sickle cell anemia due to hemoglobin S.

98. *What is the defect in HbS?*

A. Normally the 6th amino acid in the beta chain of globin is glutamic acid. This is replaced by valine in the HbS molecule.

99. *What is iso-electric point of a protein?*

A. At the isoelectric point (pI), the number of anions and cations present on the protein molecule will be equal and the net charge is zero.

100. *What are the characteristic features of iso-electric point?*

A. At the pI value, the proteins will not migrate in an electrical field; solubility, buffering capacity and viscosity will be minimum and precipitation will be maximum.

101. *What is the iso-electric pH of human albumin?*

A. 4.7.

102. *How proteins are precipitated from solution?*

A. Any factor, which neutralizes the charge or removes water of hydration will cause precipitation of proteins.

103. *What is salting out of proteins?*

A. precipitation of proteins by adding large amount of salts. Globulin is precipitated by adding 50% saturated ammonium sulfate solution.

104. *What is salting in of proteins?*

A. Increase solubility of a substance by adding small amounts of salts. Globulin is insoluble in water. Addition of small amount of ammonium sulfate increases its solubility.

105. *How is albumin precipitated?*

A. By full saturation of ammonium sulfate.

106. *What will be precipitated by half-saturation of ammonium sulfate?*

A. Globulins.

107. *What is protein denaturation?*

A. Unfolding and loss of secondary, tertiary and quaternary structure. Denaturation does not affect primary structure i.e. not accompanied by hydrolysis of peptide bonds.

108. *What are the effects of protein denaturation?*

A. The biological activity is lost. In addition, the denatured proteins are insoluble and easily precipitated.

109. *What are the usual agents that cause denaturation of proteins?*

A. Heating, organic solvents, heavy metals, urea, X-ray, enzymes, and vigorous mechanical mixing.

110. *What is heat coagulation?*

A. When some proteins are heated at isoelectric point, they will denature irreversibly to produce thick floating coagulum.

111. *Give examples of proteins that coagulate easily.*

A. albumin and globulins.

112. *How proteins are classified?*

A. They may be classified depending on the function or based on physiochemical characteristics or based on their nutritional value.

113. *What is the functional classification of proteins?*

A. (1) Catalytic proteins, (2) Structural proteins, (3) Contractile proteins, (4) Transport proteins, (5) Regulatory proteins (hormones), (6) Genetic proteins, and (7) Protective proteins.

114. *Based on physiochemical properties, how are they classified?*

A. Simple proteins, conjugated proteins and derived proteins.

115. *Give examples of simple proteins.*

A. Albumin, globulins, globin, protamines, gliadins, glutelins, and scleroproteins.

116. Give examples of scleroproteins.

A. Collagens (of bone, cartilage and tendon), keratin (of hair, skin, nail and enamel of teeth), elastin (of lung and blood vessels) and reticulin.

117. *What are conjugated proteins?*

A. Combinations of protein with a non-protein part (which is called prosthetic group).

118. *How are conjugated group subclassified?*

A. Phosphoproteins, lipoproteins, glycoproteins, metalloproteins, chromoproteins, and nucleoproteins,.

119. *Give example of metaloproteins ?*

A. Metaloproteins containing iron, copper, zinc, magnesium and selenium.

120. *Give example of metaloproteins containg iron ?*

A. Heme iron containing proteins (hemoglobin, myoglobin, tryptophan oxygenase, cytochromes, catalase and peroxidase enzyme). Non-heme iron containing proteins (ferritin, transferrin and hemosedrin)

121. *Give example of metaloproteins containg copper ?*

A. Ceruloplasmin, erythrocuprein, hepatocuprein, cerebrocuprein and oxidase enzymes.

122. *Give example of metaloproteins containg zinc ?*

A. Insulin hormone and some enzymes e.g. carbonic anhydrase.

123. *Give example of metaloproteins containg magnesium ?*

A. Some enzymes as kinase and phosphatase.

124. *Give example of metaloproteins containg selenium?*

A. Glutathione peroxidase.

125. *Give some examples of chromoproteins.*

A. Metalochromoproteins as hemoglobin and non-metalochromoproteins as flavoproteins, and visual purple.

126. *Give examples of phosphoproteins.*

A. Casein of milk and vitellin of egg yolk.

127. *Where is this phosphate attached to proteins?*

A. The phosphoric acid is added to the hydroxyl groups of serine and threonine residues of proteins.

128. *Give an example of a nutritionally rich protein (first class protein).*

A. Casein.

129. *Some proteins are called as poor proteins; why?*

A. They lack in many essential amino acids and a diet based on these proteins will not sustain the body health.

130. *Give an example of nutritionally poor protein.*

A. Maize (corn) lacks tryptophan.

131. *Which method of protein estimation is dependent on the intact peptide bond?*

A. Biuret method.

132. *What does biuret mean?*

A. The name is derived from the compound biuret, a condensation product of two urea molecules, which also gives a positive color test.

133. *What is biuret reaction?*

A. Cupric ions in alkaline medium form a violet color with peptide bond nitrogen of proteins.

134. *What is the use of biuret reaction?*

A. This reaction can be used for qualitative identification and quantitative estimation of all proteins.

135. *Will amino acids give a positive biuret test?*

A. No. This needs a minimum of two peptide bonds.

136. *Will urea give a positive biuret test?*

A. Yes.

137. *What is the advantage of biuret method?*

A. The biuret method is simple one step process, and is the most widely used method for plasma protein estimation.

138. *What is the disadvantage of biuret method?*

A. The sensitivity of the method is less and is unsuitable for estimation of proteins in milligram or microgram quantities.

139. *Which component of the protein absorb UV light at 280 nm?*

A. Indole ring of tryptophan.

140. *Give examples of basic simple proteins.*

A. Globulins (histones) and protamines.

141. *Give examples of acidic simple proteins.*

A. Gliadins and glutelins.

142. *What are derived proteins?*

A. Primary derived: denaturated proteins and secondary derived: Hydrolytic products.

143. *What are proteins containing much of cysteine?*

A. Keratins.

144. *What are proteins containing much of methionine?*

A. Casein.

145. *What are proteins containing much of serine and methionine?*

A. Phosphoproteins as casein.

146. *What are proteins containing much of histidine?*

A. Globin of hemoglobin and histones of DNA.

147. *What are proteins containing much of proline and hydroxyproline?*

A. Collagen and gelatin

148. *What is collagen?*

A. One of scleroproteins. Collagen forms about 30% of total body proteins. There are more than 12 types of collagen, but the most common in human body is type I, which constitutes about 90% of cell collagen.

149. *Where is collagen found in the body?*

A. It is protein of connective tissue present in skin, bones, tendons and blood vessels. Collagen may be present as a gel e.g. in extracellular matrix or in vitreous humor of the eye.

150. *What is the structure of collagen?*

A. Collagen molecules consist of 3 polypeptide chains called α-chains; each is about 1050 amino acids. They are twisted around each other forming triple helix molecule. Collagen contains 33% glycine, 10% proline, 10% hydroxyproline and 1% hydroxylysine. Collagen is present in the form of glycoprotein.

151. *What are the post-translational modifications taking place in collagen?*

A. Hydroxylation of proline and lysine residues, and hydrolysis of pro-collagen.

152. *Hydroxylation of proline and lysine needs what?*

A. It depends on vitamin C.

153. *In ascorbic acid deficiency, what happens?*

A. Scurvy, where there is a poor hydroxylation, and defective collagen synthesis.

154. *Why collagen has a very firm structure?*

A. This because (1) each helical turn contains only 3 amino acids. For other proteins, each turn contains 3.6 amino acids. (2) Glycine (the smallest amino acid) forms 33% of total molecule. This makes the polypeptide chains compact. (3) The high content of hydroxyproline and hydroxylysine increase the number of hydrogen bonds.

155. *What is α-keratin?*

A. One of scleroproteins. They are found in hair, nail, enamel of teeth and outer layer of skin. They are α-helical polypeptide chains. They are rich in cysteine disulfide bonds between adjacent polypeptide chains. It is insoluble due to their high content of hydrophobic amino acids.

156. *What is elastin?*

A. *It is one of scleroproteins.* It is rubber like i.e. can be stretched to several times as their normal length. Elastin is similar to

collagen, being rich in glycine and proline. It is poor in hydroxyproline and hydroxylysine.

157. *Why elastin is rubber like?*

A. Elastin is formed of 4-polypeptide chains that are interconnected by desmosine. This allows the elastin to stretch in 2 ways.

158. *Where is elastin found in the body?*

A. It is a connective tissue protein. It is present in lungs, the walls of large blood vessels and elastic ligaments.

159. *What is the role of α-antitrypsin in elastin degradation ?*

A. α1-antitrypsin is an enzyme produced mainly by liver, neutrophils, monocytes and macrophages. It is present in blood and other body fluids. In the lung, it inhibits elastase enzyme, which is produced by neutrophils.

160. *What is the effect of α-antitrypsin deficiency ?*

A. Deficiency of α-1-antitrypsin → ↑ Elastase enzyme → destruction of elastin in alveolar wall → Emphysema.

161. *What are hemoproteins?*

A. Hemoproteins are conjugated protein formed of protein part (globin) and nonprotein prosthetic part (heme). Heme contains iron (red in color). Thus hemoproteins are considered metaloproteins.

162. *What are heme containing compounds?*

A. Hemoglobin, Myoglobin, cytochrome enzymes, catalase enzyme, peroxidase enzymes, and tryptophan dioxygenase enzyme.

163. *What is myoglobin?*

A. It is found only in red skeletal muscles and cardiac muscle. It gives these tissues their characteristic color. It is formed of one heme molecule attached to one polypeptide chain called apomyoglobin. Myoglobin has much higher affinity for oxygen than hemoglobin. It is unable to release it except under very low oxygen tension (during severe muscular exercises). Myoglobin concentration is increased in blood in a disease called myocardial infarction (=cardiac muscle disease).

164. *Why proteins are amphoteric?*

A. Proteins contain free amino group (N-terminal) and contain free amino groups of basic amino acids. Proteins contain free carboxylic group (C-terminal) and contain free carboxylic group of acidic amino acid. The presence of both free amino and carboxyl groups makes the protein amphoteric compound and it can act as a buffer. Proteins are positively charged in acidic medium and negatively charged in alkaline medium.

165. What are methods of protein separation?

A. Chromatography, electrophoresis, ultracentrifugation, nephelometry and dialysis.

166. What is chromatography?

A. Chromatography is a group of separation techniques, where a mixture of molecules is separated into its components. The separated molecules are divided between a stationary and mobile phases. The separation process depends on the tendency of one type of molecules in the mixture to associate more strongly with one phase than the other.

167. What is the principle of partition chromatography?

A. The components of the mixture to be separated are partitioned between the two phases depending on the partition co-efficient (solubility) of the particular substances.

168. What are the common types of partition chromatography?

A. Paper chromatography and thin layer chromatography (TLC).

169. What is the advantage of TLC over paper chromatography?

A. TLC needs lesser time, and separation is more effective.

170. What is Rf value?

A. It is the ratio of the distance travelled by the substance (solute) to the distance traveled by the solvent. The Rf value is a constant for a particular solvent system at a given temperature.

171. What is the basic principle of ion-exchange chromatography?

A. Here, the separation is based on electrostatic attraction between charged molecules to oppositely charged groups on the ion exchange resins.

172. What is the principle of gel filteration chromatography?

A. The separation is effected on the basis of the size of the molecules. It is otherwise called molecular sieving.

173. What is the principle of ultracentrifugation?

A. Large molecules can be sedimented at high centrifugal forces whereas small molecules cannot. Rate of sedimentation depends on the size, shape and density of solute particles.

174. What is Svedberg unit?

A. Sedimentation constant is expressed in Svedberg (S) units.

175. What are the uses of ultracentrifugation?

A. (1) Separation of subcellular organelles. (2) Separation of lipoproteins. (3) Determination of molecular weight of proteins.

176. *What is electrophoresis?*

A. It is the movement of charged particles in an electric field towards the oppositely charged electrode.

177. *What is the importance of electrophoresis?*

A. By electrophoresis, a mixture of amino acids, polypeptides or proteins can be separated by using electric current.

178. *What are the factors affecting the mobility in electrophoresis?*

A. Net charge on the proteins particles, mass and shape of the particles, the pH of the medium, strength of electrical field, and properties of the supporting medium.

179. *What are the supporting media used?*

A. Filter paper, cellulose acetate, agar gel, agarose gel, starch gel and polyacrylamide gel.

180. *Electrophoresis is commonly employed for what purpose in laboratory?*

A. For serum electrophoresis and to see abnormalities in serum protein concentrations.

181. *What is dialysis?*

A. Dialysis means separation of colloids from crystalloids. Thus proteins, which have a high molecular weight and form a colloidal solution can be separated from salts (crystalloids) by dialysis i.e. by using a semi-permeable membrane. Crystalloids can pass through this membrane, while colloids cannot due to the large size of their particles.

182. *What is nephelometry?*

A. Nephelometry is defined as the detection of light scattered by turbid particles in solution (protein solution).

183. *What is myosin?*

A. It is a speciallised protein seen in muscle.

184. *What is its biological function?*

A. It can bind actin to form actinomyosin. It has ATPase activity.

185. What is the function of Troponin-C?

A. It binds calcium.

186. *What is the function of Troponin-I?*

A. ATPase inhibitory element.

187. *What is the clinical significance of Troponin-T?*

A. Its serum level is increased in myocardial infraction.

188. *compare between albumin and globulin.*

	Albumin	Globulins
Coagulation by heat	Coagulable	Same
Biological value	Protein of high biological value	Same
Solubility	Soluble in water	Soluble in salt solution
Molecular weight	68,000	150,000
Precipitation	By full saturation of ammonium sulfate	By half saturation of ammonium sulfate
Sources • Blood • Milk • Egg	 Serum albumin Lactalbumin Egg albumin	 Serum globulin Lactglobulin Egg globulin

189. *compare between globin and protamin.*

	Globin	Protamine
Type of basic amino acid	Histidine	Lysine and arginine
Solubility	In salt solution	In salt solution In 70% ethanol
Sources • In plant and animals • In RBCs	 -Combined with DNA -Combined with heme to form hemoglobin	In fish

190. *compare between fibrous and globular proteins.*

	Fibrous	Globular
Axial ratio	More than 10	Less than 10
Stability	More stable	Less stable
Examples:	Keratin and myosin of muscles	Albumin, globulin and insulin

191. *compare between collagen and elastin.*

	Collagen	Elastin
Number of chains	3	4
Amino acids content	33% Glycine Rich in proline More hydroxyproline Contains hydroxylysine	33% Glycine Rich in proline Less hydroxyproline Contains NO hydroxylysine
Structure	Fibrous	Fibrous in extended form Globular in relaxed form.
Direction of stretch	One direction	2 Direction

192. *compare between myoglobin and hemoglobin.*

	Myoglobin	Hemoglobin
Location	In skeletal and cardiac muscles	In RBCs
Structure	One heme and one polypeptide chain	4 heme molecules and 4 polypeptide chains
Affinity to oxygen	High	less
Function	Supply oxygen to muscles.	Supply oxygen to all body cells.

MCQ, Matching, True and False and Completion

Select and encircle the most appropriate answer or completion:

1) *Phenylalanine is:*
   - A) Branched amino acid.
   - B) Basic amino acid.
   - C) Imino acid.
   - D) Essential amino acid.
   - E) Acidic amino acid

2) *Keratin is:*
   - A) Fibrous protein.
   - B) Globular protein
   - C) Tripeptide.
   - D) Histone.
   - E) Conjugated protein.

3) *Tryptophan may be detected in a mixture of amino acids by the:*
   - A) Millon reactions
   - B) Nitroprusside reaction
   - C) Rosenheim's reaction
   - D) Xantheproteic reaction
   - E) Biuret reaction

4) *Ninhydrine reacts with amino acids by causing:*
   - A) Dehydrogenation
   - B) Deamination
   - C) Deamination and decarboxylation
   - D) Cleavage of certain peptide bonds
   - E) Oxidative decarboxylation

5) *Rotation of plain polarized light is caused by solution of all the following amino acids EXCEPT:*
   - A) Alanine
   - B) Glycine
   - C) Leucine
   - D) Serine
   - E) Valine

6) *The following are biologically active peptides EXCEPT;*
   - A) Aspartame
   - B) Glutathione
   - C) Natriuretic factor
   - D) Elastin
   - E) Bradykinin

7) *β-Lipotropin:*
   - A) It is the precursor of β-endorphin.
   - B) It is the precursor of β-glucopyranose.
   - C) Peptide enters in the structure of β-pleated protein sheets.
   - D) It is peptide produced by cardiac cells.
   - E) Its tripeptide formed of glutamate – Cystein – Glycine.

8) *An essential amino acid in man is:*
   A) Proline.
   B) Tyrosine.
   C) Methionine.
   D) Serine.
   E) Glycine

9) *Which of the following amino acids can be metabolized to fatty acids in mammals:*
   A) Leucine
   B) Methionine
   C) Arginine
   D) Alanine
   E) Glutamate

10) *Among the techniques used for separation of proteins and amino acids are:*
   A) Chromatography
   B) Electrophoresis
   C) Ultracentrifugation
   D) All of the above
   E) None of the above

11) *Histones are:*
   A) Proteins present in egg yolk.
   B) Identical to globin.
   C) Identical to protamine.
   D) Acidic proteins.
   E) Coagulated by heat.

12) *Formed of 3 α-polypeptide chains; and contains about 33% glycine:*
   A) Keratin
   B) Collagen
   C) Albumin
   D) Elastin

13) *Thyroxin hormone is derived from:*
   A) Tyramine.
   B) Tyrosine.
   C) Tryptophan.
   D) Taurine.
   E) Tryptamin.

14) *Primary structure of proteins is determined by:*
   A) Peptide bonds
   B) Hydrogen bonds
   C) Disulfide bonds
   D) Electrostatic bond
   E) Hydrophobic bonds

15) *Secondary structure of proteins is determined by:*
   A) Peptide bonds
   B) Hydrogen bonds
   C) Disulfide bonds
   D) Electrostatic bond
   E) Hydrophobic bonds

16) *Isoelectric pH is the pH at which:*
   A) Protein molecule is denaturated.
   B) Protein molecule carries no net charges.
   C) Protein molecule is most soluble.
   D) The disulfide bonds in protein molecule are disrupted.

17) *The protein bond that is NOT lost by denaturation is:*
- A) Peptide bonds
- B) Hydrogen bonds
- C) Disulfide bonds
- D) Electrostatic bond
- E) Hydrophobic bonds

18) *Tertiary structure of proteins is determined by:*
- A) Hydrogen bonds
- B) Disulfide bonds
- C) Electrostatic bonds
- D) Hydrophobic bonds
- E) All of the above

19) *The zwitter ion is:*
- A) The dipolar ion
- B) Positively charged ions
- C) Negatively charged ions
- D) None charged ions

20) *All the following amino acids enter in the structure of proteins EXCEPT:*
- A) Glycine
- B) Homoserine
- C) Phenylalanine
- D) Alanine

21) *Glycine is characterized by:*
- A) Shows no optical activity
- B) Contains no asymmetric carbon atoms
- C) The smallest amino acid
- D) None polar amino acid
- E) All of the above

22) *Ornithin is:*
- A) Basic amino acid
- B) Essential amino acid
- C) Present in protein structure
- D) All of these

23) *The only amino acid that is ketogenic but NOT glycogenic is:*
- A) Isoleucine
- B) Tyrosine
- C) Leucine
- D) Phenyl alanine
- E) Lysine

24) *A sulfur containing amino acid that is NOT found in proteins is:*
- A) Homoserine
- B) Homocysteine
- C) Methionine
- D) Cysteine
- E) Threonine

25) *Methionine and threonine are:*
- A) Phenol containing amino acids.
- B) Basic amino acids
- C) Acidic amino acids
- D) Non-essential amino acids.
- E) Essential amino acids

26) *All of the following about protein denaturation is true **EXCEPT**:*
- A) It is loss of primary, secondary, tertiary and quaternary structures.
- B) It causes loss of biological activity of proteins.
- C) Denaturated proteins are easily precipitated.
- D) Strong acids can cause protein Denaturation

27) *Cysteine, cystine and methionine are:*
- A) Essential amino acids
- B) Non-protein amino acids
- C) Acidic amino acids
- D) Sulfur containing amino acids

28) *elastin is:*
- A) Scleroprotein
- B) Chromoprotein
- C) Metaloprotein
- D) Phosphoprotein
- E) Glycoprotein

29) *Collagen is:*
- A) Insoluble in most protein solvents
- B) By boiling it gives gelatin
- C) Rich in glycine
- D) Very firm structure
- E) All of the above

30) *Arginine and lysine are present in excess in:*
- A) Histones
- B) Albumin
- C) Gliadins
- D) Globulin
- E) All of the above
- F) None of the above

31) *Aspartic acid and glutamic acid are:*
- A) Essential amino acids
- B) Acidic amino acids
- C) Rich in basic proteins
- D) Rich in collagen

32) *An amino acid containing guanidine group is:*
- A) Leucine
- B) Arginine
- C) Citrullin
- D) Isoleucine
- E) Lysine

33) *Ceruloplasmin is:*
- A) Chromoprotein
- B) Metaloprotein
- C) Phosphoprotein
- D) Glycoprotein

34) *Which of the following is a globular protein:*
- A) Albumin
- B) globulin
- C) collagen
- D) Myoglobin

35) *A heterocyclic amino acid is:*
- A) Tryptophan
- B) Phenyl alanine
- C) Tyrosine
- D) Lysine
- E) Isoleucine

36) *The amphoteric property of amino acids is due to the presence of:*
- A) Amino group
- B) Carboxyl group
- C) Amino and carboxyl groups
- D) Indole group
- E) Phenyl group

37) *Leucine is:*
- A) Basic amino acid
- B) Pure Ketogenic amino acid
- C) Non essential amino acid
- D) Heterocyclic amino acid
- E) None branced amino acid

38) *Which one of the following statements about the major collagen type from skin or bone is INCORRECT:*
- A) One third of the amino acids of collagen is glycine.
- B) Ascorbic acid is required for the synthesis of collagen.
- C) The collagen molecule contains nonhelical chains.
- D) Collagen molecule is trimmer composed of three monomers, each containing approximately 1050 amino acids.
- E) By boiling, collagen molecule gives gelatin.

39) *Albumin, globulin, histones and scleroproteins belong to the class of:*
- A) Simple proteins
- B) Conjugated proteins
- C) Derived proteins
- D) Basic proteins
- E) Acidic proteins

40) *All of the following are sulfur containing amino acids EXCEPT:*
- A) Cysteine
- B) Homocysteine
- C) Cystine
- D) Methionine
- E) Threonine

41) *Methionine is:*
- A) Acidic amino acid
- B) Basic amino acid
- C) Sulfur containing amino acid
- D) Hydroxyl containing amino acid
- E) Aromatic amino acid

42) *Lysine is:*
- A) Neutral amino acid
- B) Acidic amino acid
- C) Basic amino acid
- D) Heterocyclic amino acid
- E) Aromatic amino acid

43) *Collagen is rich in:*
- A) Glycine, proline and hydroxyproline
- B) Glutamate proline and hydroxyproline
- C) Glycine, cycteine and cyctine
- D) Valine, leucine and isoleucine

44) *A vasodilator substance is produce by a decarboxylation of:*
- A) Methionine
- B) Histidine
- C) Glutamate
- D) Threonine
- E) Phenylalanine

45) *Decarboxylation of tryptophan produces:*
- A) Serotonin
- B) Tyramine
- C) Tryptamine
- D) Tyrosine

46) *All of the following are hydroxy (OH) containing amino acids <u>EXCEPT</u>:*
- A) Serine
- B) homoserine
- C) Threonine
- D) Glycine

47) *Which of the following amino acid groups contains <u>ONLY</u> nonessential amino acids:*
- A) Sulfur containing amino acids
- B) Basic amino acids
- C) Aromatic amino acids
- D) Acidic amino acids

48) *An amino acids present in natural proteins is:*
- A) Ornithin
- B) β - Alanine
- C) Citrulline
- D) Homoserine
- E) Valine

49) *A phosphprotein is:*
- A) Casein
- B) Albumin
- C) Globulin
- D) Histones

50) *A basic protein associated with nucleic acids is:*
- A) Actin
- B) Myosine
- C) Histone
- D) Collagen

51) *A protein that contains 33% glycine amino acid is:*
- A) Albumin
- B) Globulin
- C) Elastin
- D) Casein
- E) Histone

52) *An imino group is present in structure of:*
- A) Proline
- B) Alanine
- C) Serine
- D) Aspartic acid

53) *Elastin is cross-linked through its:*
- A) Glutamate side chains
- B) Glutamine side chains
- C) Lysine side chains
- D) Methionine side chains

54) *Amino acids considered non essential for human are:*
- A) Those incorporated into protein.
- B) Those synthesized in the body.
- C) Those cannot decarboxylated
- D) Those cannot be transaminated.

55) *Sulfur containing amino acid is:*
- A) Keratan sulfate.
- B) Chondroitin sulfate.
- C) Cysteine.
- D) Homoserine.
- E) Glutathione.

56) *Gelatin is:*
- A) Denaturated collagen.
- B) Boiled globulin.
- C) Similar to Elastin.
- D) Conjugated protein.
- E) Precursor of scleroproteins.

57) *Desmosine cross-links are present in the structure of:*
- A) Collagen
- B) Elastin
- C) Casein
- D) Keratin

58) *Glutathione is tripeptide formed of:*
- A) Glutamate- phenylalanine – aspartate.
- B) Methionine – alanine – valine.
- C) Homocysteine – arginine – threonine.
- D) Cystine – leucine – Aspartate.
- E) Glutamate – cystein – Glycine.

59) *The terms "primary", "secondary" and "tertiary" structure in protein chemistry refer to:*
- A) "α-Helix", "β-helix" and "γ-helix" respectively.
- B) "Amino acids sequence", "hydrophobic, electrostatic, disulfide, hydrogen bonds" and "α-helix" respectively.
- C) "Electrostatic interactions", "hydrogen bonds" and "disulfide bonds" respectively.
- D) "Amino acids sequence", "α-helix", and "hydrophobic, electrostatic, disulfide, hydrogen bonds" respectively.

60) *The following are basic essential amino acids EXCEPT:*
- A) Histidine
- B) Lysine
- C) Arginine
- D) Leucine

61) *Which one of the following statements about the major collagen type from skin or bone is CORRECT:*
- A) One third of the amino acids of collagen is hydroxyproline.
- B) Ascorbic acid is required for the synthesis of collagen.
- C) The collagen molecule contains nonhelical chains.
- D) Collagen molecule is dimmer composed of two monomers, each containing approximately 1050 amino acids.
- E) The polypeptide chains of collagen are held together by disulfide bonds.

62) *The bonds present in the primary structure of proteins are:*
- A) Hydrogen bonds
- B) Peptide bonds
- C) Disulfide bonds
- D) Electrostatic bonds
- E) All of the above

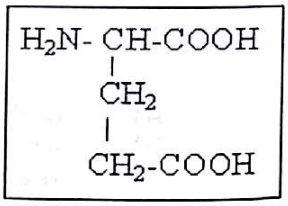
63) *All the following related to collagen is true EXCEPT:*
- A) A connective tissue protein
- B) Rich in glycine
- C) Undergo posttranslation hydroxylation
- D) Formed of two polypeptide helical chain
- E) A very compact protein molecule.

64) *In proteins, the α-helix and β-pleated sheet are example of:*
- A) Primary structure
- B) Secondary structure
- C) Tertiary structure
- D) Quaternary structure

65) *The most abundant structural protein is:*
- A) Collagen
- B) Keratin
- C) Fibronectin
- D) Elastin

66) *Which of the following groups consists entirely of amino acids which are nutritionally essential for human:*
- A) Valine, isoleucine, tyrosine, arginine
- B) Leucine, methionine, isoleucine, alanine.
- C) Glutamate, arginine, cysteine, tryptophan.
- D) Valine, isoleucine, tyrosine, lysine.
- E) Lysine, tryptophan, phenylalanine, threonine.

67) *The compound shown beside:*



- A) Is an intermediate in urea cycle
- B) Is the source of sphingosine.
- C) Is the amino acid lysine
- D) Is the source of C_4, C_5 and N_7 of purine base.
- E) Releases ammonia (NH_3) when converted to α-ketoglutarate

In the following questions indicate with clear (T) the true statements, and with clear (F) the false statements:

For proteins and peptides:

68) Glutathione is a physiological active peptide with a free SH group.
69) Dialysis means separation of protein colloids from crystalloids.
70) Denaturation of proteins disturbs primary structure of proteins.
71) Glycoproteins are considered simple proteins.
72) Disulfide and peptide bonds are weak bonds.

For amino acids:

73) Tyrosine is an aromatic essential amino acid.
74) An essential sulfur containing amino acid is methionine.
75) Amino acids have high melting points above 200°C.
76) Amino acids share in urea cycle are arginine orinithin and citruline.
77) Arginine is non-essential amino acid.

Denaturation of proteins:

78) means unfolding and loss of primary, secondary, tertiary and quaternary structure.
79) Denaturated proteins lose their biological activity.
80) Denaturated proteins are easily precipitated.
81) Repeated freezing and thawing do not cause denaturation.: cause disruption of hydrogen and other weak bonds.
82) Heavy metals as lead and mercury salts cause denaturation

Collagen:

83) Collagens form about 30% of total body proteins.
84) Collagen is deficient in glycine.
85) Collagen consist of 3 polypeptide chains called α-chains.
86) Denaturation of collagen by heating produces gelatin.
87) Scurvy is a collagen disease resulting from deficiency in ascorbic acid.

In the figure of polypeptide below:

88) Glutamate is an aromatic essential amino acid.
89) The N-terminus is located in glycine residue.
90) Serine is the site of phosphate attachment.
91) Hydroxyproline is synthesized post-translationally
92) Phenylalanine contains indole ring.

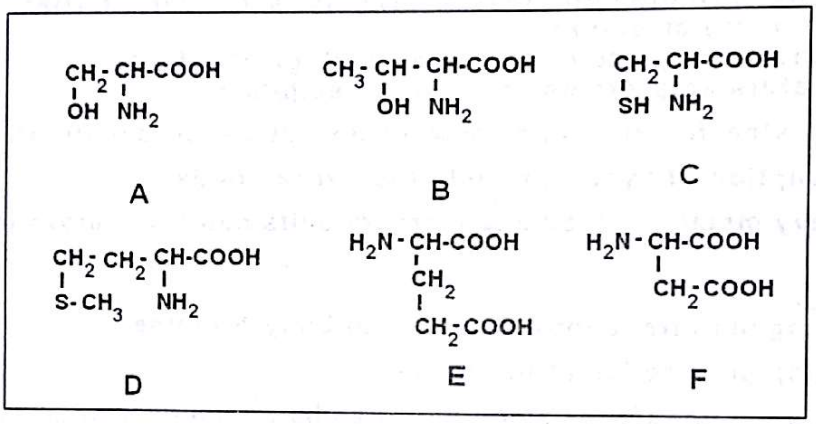
glycine – serine – cystine - glutamate – aspartate – asparagine – methionine – cystine – phenylalanine

Matching: For each set of numbered questions, choose the ONE BEST answer from the list of lettered options below it. An answer may be used once or more times, or not at all.

93) *Sulfur containing amino acid*
94) *Basic amino acid*
95) *Acidic amino acid*
96) *Imino acid*
97) *Aromatic amino acid*

A) Proline
B) Methionine
C) Glycine
D) Phenylalanine
E) Lysine
F) Glutamate
G) Threonine

98) *Aspartic acid*
99) *Serine*
100) *Methionine*
101) *Cysteine*
102) *Threonine*



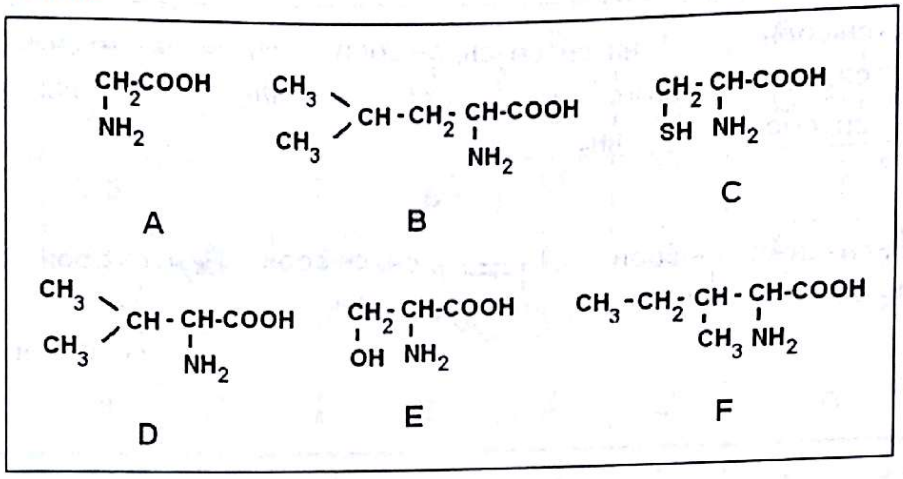
103) *Indole containing amino acid*
104) *Imidazole containing amino acid*
105) *Phenol containing amino acid*
106) *Imino acid*
107) *Acidic amino acid*

A) Proline
B) Methionine
C) Tyrosine
D) Histidine
E) Threonine
F) Tryptophan
G) Aspartate

108) *Alanine*
109) *Leucine*
110) *Tyrosine*
111) *Glutamate*
112) *Isoleucine*

A) Ketogenic
B) Glycogenic
C) Ketogenic and glycogenic

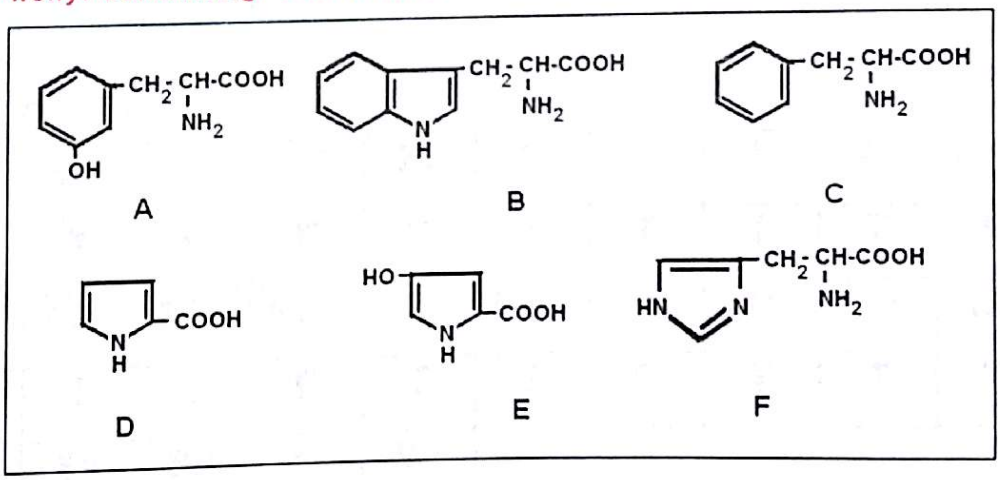
113) *Leucine*
114) *Glycine*
115) *Isoleucine*
116) *Cysteine*
117) *Valine*



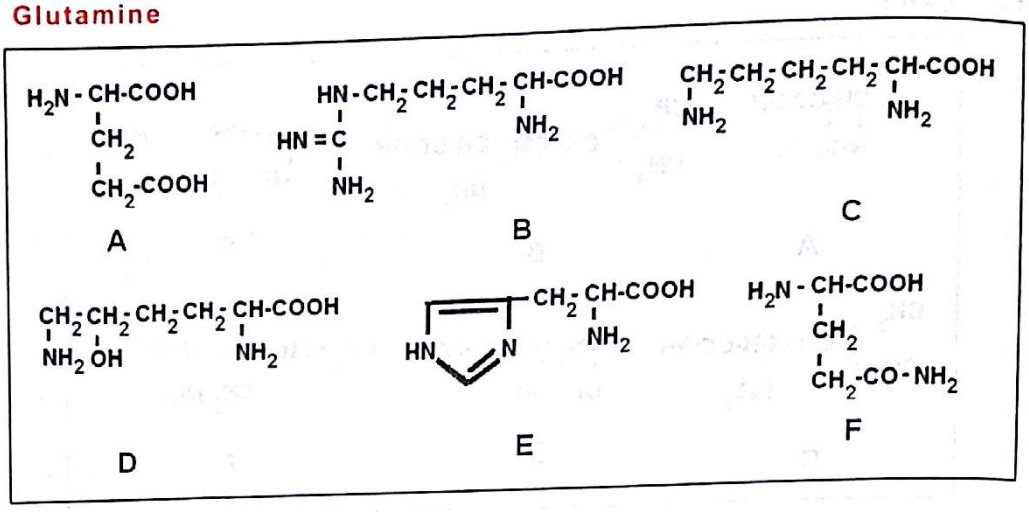
118) *Guanido group*
119) *Thiol group*
120) *Imidazole group*
121) *pyrrolidine group*
122) *Ureido group*

A) Phenyl alanine
B) Hydroxyproline
C) Histidine
D) Arginine
E) Cysteine
F) Citrulline
G) Serine

123) *Indole containing amino acid*
124) *Imidazole containing amino acid*
125) *Phenol containing amino acid*
126) *hydroxyimino acid*
127) *Phenyl containing amino acid*



128) Arginine
129) Hydroxylysine
130) Glutamate
131) Lysine
132) Glutamine



Answer Key

MCQ:

1	2	3	4	5	6	7	8	9	10
D	A	C	C	B	D	A	C	A	D
11	12	13	14	15	16	17	18	19	20
B	B	B	A	B	B	A	E	A	B
21	22	23	24	25	26	27	28	29	30
E	A	C	B	E	A	D	A	E	F
31	32	33	34	35	36	37	38	39	40
B	B	B	D	A	C	B	C	A	E
41	42	43	44	45	46	47	48	49	50
C	C	A	B	B	D	D	E	A	C
51	52	53	54	55	56	57	58	59	60
C	A	C	B	C	A	B	E	D	D
61	62	63	64	65	66	67			
B	B	D	B	A	E	E			

True and false:

68	69	70	71	72	73	74	75	76	77
T	T	F	F	F	T	T	T	T	F
78	79	80	81	82	83	84	85	86	87
F	T	T	F	T	T	F	T	T	T
88	89	90	91	92					
F	T	T	T	F					

Matching:

93	94	95	96	97	98	99	100	101	102
B	E	F	A	D	F	A	D	C	B
103	104	105	106	107	108	109	110	111	112
F	D	C	A	G	B	A	C	B	C
113	114	115	116	117	118	119	120	121	122
B	A	F	C	D	D	E	C	B	F
123	124	125	126	127	128	129	130	131	132
B	F	A	E	C	B	D	A	C	F

Chapter 4 *Vitamins*

1. *What are vitamins?*
   A. (1) Are organic compounds, (2) essential for life, (3) cannot be synthesized by the body, (4) not enter in the structure of the tissues or oxidized by them and (5) they are needed in very small amounts.
2. *What are vitamers?*
   A. These are different forms of one vitamin e.g. Vitamin D has two vitamers: D_2 & D_3.
3. *What are pro-vitamins?*
   A. These are precursors of vitamins that are converted into vitamins inside the body e.g. 7-dehdrocholesterol is provitamin D_3.
4. *What are fat soluble vitamins?*
   A. These are vitamins D, E, K and A.
5. *What are the sources of Vitamin A?*
   A. Carrot, green leafy vegetables, and fish liver oil.
6. *What is the pro-Vitamin A?*
   A. β- carotene present in plants.
7. *What is the major function of Vitamin A?*
   A. Night vision.
8. *What are the other biological roles of Vitamin A?*
   A. Normal maintenance of epithelium and skin, glycoprotein synthesis, reproduction, cell differentiation, and anti-oxidant role.
9. *What is visual cycle?*
   A. Rhodopsin consists of protein called opsin bound to 11-cis retinal. When rhodopsin is exposed to light, 11 cis retinal is converted into all trans retinal. All trans retinal changes the permeability of cell membrane of rod cells. This allows the calcium ions to pass out of the cell membrane. This stimulates the nerve impulse in optic nerve. Thus the brain perceives light.

10. What are causes the nerve impulse in the retina?

A. Conversion (isomerisation) of 11-cis retinal to all trans retinal.

11. How is 11 cis retinal regenerated?

A. All trans-retinal is taken to liver, where it is made to trans-retinol, then isomerizes to cis-retinol and then to cis retinal.

12. What are the enzymes required for this regeneration?

A. Alcohol dehydrogenase and retinol isomerase.

13. How vitamin A is absorbed?

A. In the intestinal mucosal cells, β-carotene is converted into retinal. Retinal is re-esterified with palmitic acid and transported to the liver, where 90% of the body's vitamin A is stored.

14. How does vitamin A circulate in blood?

A. In association of retinal binding protein (RBP) (formed by the liver).

15. What are the deficiency manifestations of Vitamin A?

A. Night blindness, xero-ophthalmia, keratomalacia, and keratinisation of epithelium leading to roughness of skin (goose skin) and mucus membranes.

16. Why over-dosage of vitamin A and D is toxic?

A. Because these vitamins are transported in association with albumin. If the concentration of vitamins exceeds the capacity of transporting albumin, free vitamins will be released in blood and tissues are exposed to their toxic effect.

17. What is the daily requirement of Vitamin A?

A. 5000 IU/day.

18. How cholecalciferol (D_3) is synthesized?

A. From the provitamin 7-dehydrocholesterol present in subcautanous fat by the action of ultra violet rays.

19. How Vitamin D is activated?

A. Cholecalciferol (D3) from subcutaneous tissue reaches liver. There it is hydroxylated to form 25-hydroxy cholecalciferol (25-HCC). It passes then to the kidney, where further hydroxylation takes place at position 1 to form 1,25-dihydroxy cholecalciferol (DHCC).

20. What is calcitriol?

A. It is an active vitamin D (1,25 dihydroxy cholecalciferol). It contains three hydroxyl groups at 1 , 3 and 25 positions. Therefore, it is called calcitriol.

21. Which Vitamin acts as a pro-hormone?

A. Vitamins A and D.

22. What is the function of Vitamin D?

A. It increases absorption of calcium from intestine. This leads to normalization of serum calcium. It also increases mineralization of bone.

23. How calcitriol increases absorption of calcium?

A. By stimulating synthesis of calbindin (calcium binding protein) in the intestinal mucosal cell.

24. What is the mechanism of calcium absorption?

A. calcitriol stimulates DNA in the intestinal mucosal cell causing transcription of specific genes that code for synthesis of calbindin. This increases the absorption of calcium.

25. Explain why active vitamin D is considered as a hormone?

A. Because its action through stimulation of DNA is similar to action of steroid hormoes.

26. Which vitamins are steroid in nature?

A. Vitamin D is the only vitamin belonging to steroids.

27. What is the relation of parathyroid hormones and calcium metabolism?

A. Hypocalcaemia causes release of parathyroid hormone → Activation of renal 1 hydroxylase enzyme → Conversion of 25 (OH) D_3 into 1,25 $(OH)_2$ D_3 → Increase calcium absorption.

28. How is vitamin D deficiency manifested?

A. Rickets in children and osteomalacia in adults. These diseases are characterized by demineralization of bones.

29. In renal disease, oral doses of Vitamin D may not be effective, why?

A. Hydroxylation at position 1 and activation of vitamin is taking place in kidney.

30. What are the causes of rickets?

A. Under exposure to sunlight, chronic renal failure and liver diseases.

31. What are vitamins important for bones?

A. Vitamin D, vitamin A and vitamin C.

32. What is the daily requirement of Vitamin D?

A. 400 IU/day.

33. What is the chemical nature of Vitamin E?

A. α - tocopherol.

34. What is the function of Vitamin E?

A. Anti-oxidant.

35. What is the relation of Vitamin E and heart diseases ?

A. Vitamin E acts as antioxidant. It prevents oxidation of LDL.

Oxidized LDL causes atherosclerosis.

36. *What is the relationship of selenium with Vitamin E?*

A. They act synergistically as antioxidants.

37. *What is the source of Vitamin E?*

A. Vegetables and seed oils as sunflower oil, safflower oil, cotton seed oil, and palm oil.

38. *What is the normal daily requirement of Vitamin E?*

A. 15 IU/day.

39. *What is the chemical nature of vitamin K?*

A. Napthoquinone derivative.

40. *What is menadione?*

A. It is synthetic water soluble Vitamin K, widely used in clinical practice.

41. *What is the function of Vitamin K?*

A. (1) Synthesis of some blood clotting factors in liver through δ - carboxylation of factors II (prothrombin), VII, IX and X. (2) Vitamin K also maintains synthesis of osteocalcin (calcium binding protein) in bones.

42. *Deficiency of Vitamin K can occur in which conditions?*

A. Obstructive jaundice, antibiotic therapy, new born infant and long use of dicumarol.

43. *Why bleeding tendency is common in obstructive jaundice?*

A. Bile slats essential for absorption of vitamin K are synthesized in liver and decreased in obstructive jaundice. This causes defective synthesis of coagulation factors.

44. *What is the mechanism of action of dicoumarol?*

A. It competitively inhibits Vitamin K epoxide reductase.

45. *So, dicoumarol is used for what purpose?*

A. To prevent intravascular thrombosis.

46. *Excess dicoumarol will produce what?*

A. Bleeding tendency.

47. *Which substance will inhibit Vitamin K?*

A. Dicoumarol.

48. *Why Vitamin K is deficient in neonates?*

A. Intestine in the first week of life contains no bacteria that synthesize vitamin K.

49. *Bleeding tendency is common in the deficiency of which?*

A. Vitamin K,Vitamin C,and platelets.

50. *What are water soluble vitamins?*

A. C and B complex group (11 vitamins).

51. *Explain why all vitamins of B complex are grouped together?*
A. Because all share the same sources e.g. yeast, liver, egg yolk, milk and whole grain cereals.

52. *What are good sources of thiamine?*
A. Whole grain cereals, Whole-wheat flour, unpolished rice and yeast.

53. *Which vitamin is required for oxidative decarboxylation reactions?*
A. Thiamine pyrophosphate.

54. *Which enzymes require thiamine pyrophosphate?*
A. Pyruvate dehydrogenase, α-keto glutarate dehydrogenase and transketolase.

55. *What are the functions of vitamin B_1?*
A. (1) In oxidative decrboxylation of keto acids (as conversion of pyruvic acid to acetyl CoA) (2) In transketolation in pentose phosphate pathway. (3) TPP is also essential for the process of nerve conduction and structure of nerve membrane.

56. *In thiamine deficiency, what alterations are seen in blood?*
A. Increased pyruvic acid level and increased transketolase activity.

57. *Beriberi is due to the deficiency of which vitamin?*
A. Vitanin B1 (thiamine).

58. *Chronic alcoholism may lead to the deficiency of which Vitamin?*
A. Vitamin B1.

59. *What is the daily requirement of Vitamin B1 (thiamine)?*
A. 1.5 mg / day.

60. *What is the coenzyme function of riboflavin (B2)?*
A. FMN and FAD dependent enzymes.

61. *What is the importance of vitamin B_2?*
A. Riboflavin enters in the structure of FMN and FAD, which are coenzymes act as hydrogen carriers.

62. *What are the FAD dependent enzymes?*
A. Succinate dehydrogenase, acyl CoA dehydrogenase, xanthine oxidase, glutathione reductase, glycine cleavage system, pyruvate dehydrogenase, and alpha keto-glutarate dehydrogenase.

63. *What are the manifestations of riboflavin deficiency?*
A. Glossitis, cheilosis, angular stomatits, and corneal vascularization.

64. *What is the dietary sources of riboflavin?*
A. Liver, dried yeast, egg, and milk.

65. *What is the daily requirement of riboflavin?*

A. 1.5 mg / day.

66. *What are the coenzymes derived from niacin?*

A. NAD and NADP.

67. *Name some important NAD dependent enzymes.*

A. Lactate dehydrogenase, glyceraldehyde-3-phosphate dehydrogenase, pyruvate dehydrogenase, β-hydroxy acyl CoA dehydrogenase, and mitochondrial isocitrate dehydrogenase.

68. *What is the importance of niacin?*

A. (1) Niacin enters in the structure of NAD and NADP, which are coenzymes act as hydrogen carriers. (2) Niacin lowers plasma cholesterol.

69. *Name the NADPH generating reactions.*

A. Glucose-6-phosphate dehydrogenase, 6-phosphogluconate dehydrogenase, malic enzyme, and cytosolic isocitrate dehydrogenase.

70. *What are the important NADPH utilising reactions?*

A. β-keto acyl CoA dehydrogenase, α, β unsaturated acyl CoA dehydrogenase, HMG CoA reductase, met-hemoglobin reductase, dihydrofolate reductase, and phenylalanine hydroxylase.

71. *Pellagra is seen in the deficiency of which Vitamin?*

A. Niacin.

72. *What are the features of pellagra?*

A. Dermatitis, diarrhea, and dementia.

73. *What is the precursor of niacin?*

A. Tryptophan.

74. *Tryptophan will give rise to how much niacin?*

A. About 60 mg of tryptophan will give 1 mg of niacin.

75. *Tryptophan is deficient in which food stuff?*

A. Maize and corn.

76. *Which conditions will lead to symptoms of pellagra?*

A. Low tryptophan content in diet, niacin deficiency, B6 deficiency, hartnup disease, and carcinoid syndrome.

77. *Which drugs will lead to symptoms of pellagra?*

A. Isoniazid therapy.

78. *What are dietary sources of niacin?*

A. Whole grain cereals, milk, meat, liver, yeast. Niacin can also be synthesized endogenously from the amino acid trytophan.

79. *What is the daily requirement of niacin?*

A. 20 mg / day.

80. *Transamination reaction requires which vitamin?*

A. Pyridoxal phosphate.

81. *Pyridoxal phosphate is required for what reactions?*

A. Mainly transamination of amino acids, decarboxylation of amino acids, heme synthsis.

82. Give examples of transamination reactions.

A. Aspartate transaminase (AST) which catalyzes the reaction, aspartate to oxaloacetate and alanine transaminase (ALT) which catalyzes the reaction, alanine to pyruvate.

83. Give some examples of decarboxylation reactions.

A. Glutamate to GABA (gamma aminobutyric acid), histidine to histamine, 5-hydroxy tryptophan to serotonin, cysteine to taurine, and serine to ethanol amine.

84. *What are vitamins important for hydrogen carriage?*

A. Vitamin B_2, nicotinic acid and Lipoic acid. Vitamin C in its oxidized form may have a role.

85. *What are the manifestations of pyridoxal deficiency?*

A. Pellagra, Infantile convulsions, anemia, cancer breast, and disturbance in amino acids metabolism.

86. *What is the reason for mental retardation in pyridoxal deficiency?*

A. Due to disturbance in amino acids metabolism.

87. *What is the reason for infantile convulsions in pyridoxal deficiency?*

A. Pyridoxal phosphate is required for the formation of GABA that acts as an inhibitory neurotransmitter. Absence of the vitamin leads to hyper-excitation and convulsions.

88. *What is the reason for pellagra-like disease in pyridoxal deficiency?*

A. Because pyridoxal phosphate is needed for the conversion of tryptophan to niacin.

89. *Can you give an example of one vitamin deficiency leading to another vitamin deficiency?*

A. B6 deficiency leads to niacin deficiency, which is manifested as pellagra.

90. *What is the reason for anemia in pyridoxal deficiency?*

A. B6 is required for ALA synthase, a key enzyme in heme synthesis. In adults hypochromic, microcytic anemia may occur due to deficient formation of heme and hemoglobin.

91. *What are the drugs, which cause pyridoxal deficiency?*

A. Isonicotinic acid hydrazide (INH) (isoniazid) and oral contraceptives. Ethanol in the body is converted to acetaldehyde, which inactivates PLP.

92. *What are the dietary sources of pyrioxal phosphate?*

A. Yeast, wheat, cereals, egg yolk, liver, meat, milk, fish, and green leafy vegetables.

93. *What is the daily requirement of pyridoxal phosphate?*

A. 2 mg / day.

94. *Enumerate vitamins containing pyridine ring:*

A. Nicotinic acid and vitamin B_6.

95. *What are vitamins important for decarboxylation?*

A. Vitamin B_1 and Vitamin B_6.

96. *What is the importance of pantothenic acid?*

A. Pantothenic acid enters in the structure of CoA (coenzyme A) and acyl carrier protein (ACP).

97. *What is the coenzyme form of pantothenic acid?*

A. Coenzyme A.

98. *What is the function of CoA?*

A. Coenzyme A acts in the transfer of acyl groups e.g. acetyl CoA, succinyl CoA, malonyl CoA and other carboxylic acids.

99. *What is the importance of acetyl CoA?*

A. Acetyl CoA is an important intermediate in metabolism of carbohydrate, lipids and protein metabolism.

100. *What is the importance of ACP?*

A. ACP acts as acyl carrier during the reactions of extra-mitochondrial pathway for fatty acid synthesis.

101. *What is the function of biotin?*

A. CO_2 fixation in carboxylation reactions.

102. *Name some reactions dependent on biotin.*

A. Acetyl CoA carboxylase, propionyl CoA carboxylase, and pyruvate carboxylase.

103. *What is the antagonist for biotin?*

A. Avidin.

104. *What are vitamins important for CO_2 fixation?*

A. Biotin is the only vitamin used for CO_2 fixation.

105. *What are the sources of folic acid?*

A. The major source is leafy vegetables. Folic acid is present also in yeast, liver, beans and whole grain cereals

106. *What is the chemical nature of folic acid?*

A. Pteroyl glutamic acid (pteridine + PABA + glutamic acid).

107. *What is PABA?*

A. Para amino benzoic acid.

108. What is the coenzyme form of folic acid?

A. Tetrahydro folic acid.

109. What is the main function of folic acid?

A. Tetrahydro folic acid is the carrier of one carbon units.

110. Give examples of one carbon units.

A. Methyl, methylene, methenyl, formyl or formimino group.

111. What are the sources of one carbon moieties (groups).

A. β Carbon of serine, α Carbon of serine, tryptophan and histidine.

112. What are the fate of one carbon moieties (groups).

A. Synthesis of glycine, conversion of glycine to serine, conversion of homocysteine to methionine, conversion of uracil to thymine, provides C2 and C8 of purines.

113. One carbon units are carried on which atoms of H4 folate?

A. On N^5 or N^{10} or both.

114. What are the causes of folate deficiency?

A. Pregnancy, defective absorption, anticonvulsant drugs, hemolytic anemias, and dietary deficiency.

115. What is the major manifestation of folic acid deficiency?

A. Macrocytic anemia.

116. What are the laboratory findings in folic acid deficiency?

A. (1) Peripheral blood picture shows macrocytic anemia. (2) Normal folic acid level in serum is decreased. (3)FIGLU excretion is more, especially after histidine load.

117. What is FIGlu?

A. It is formimino-glutamate, which donates its formimino group to tetrahydrofolate, leaving glutamate which is then converted to α-ketoglutarate.

118. What is FIGlu excretion test?

A. In deficiency of folic acid → FIGlu excretion in urine is increased. It is useful test of folic acid deficiency.

119. What is the daily requirement of folic acid?

A. 200 ug/day. In pregnancy the requirement is increased to 400 ug/day.

120. What is the mechanism of action of sulphonamides?

A. They are anti-bacterial agents. They have structural similarity with PABA. Therefore, they competitively inhibit the enzyme responsible for the incorporation of PABA into folic acid.

121. What is the mechanism of action of trimethoprim?

A. It is bactericidal agent. It inhibits the folate reductase and so formation of THFA is reduced.

122. *What is mechanism of action of methotrexate?*

A. It inhibits dihydro-folate reductase, and is a powerful anticancer drug.

123. *What are inhibitors of folic acid?*

A. Sulphonamide, trimethoprim, and methotrexate.

124. *What are the sources of B_{12}?*

A. Meat, egg, milk and milk products. Vitamin B_{12} is not present in plant sources.

125. *What are the causes of B_{12} deficiency?*

A. Nutritional B12 deficiency, drugs induced vitamin B_{12} deficiency (as neomycin antibiotic and alcohol), decrease in absorption, pernicious anemia, atrophy of gastric mucosa, and pregnancy.

126. *Name a water soluble vitamin, which is stored in the body.*

B. Vitamin B_{12}.

127. *What is the metal present in Vitamin B_{12}?*

A. Cobalt.

128. *Why vitamin B_{12} is red in color?*

A. Because it contains cobalt element, which is red in color.

129. *What is the ring system present in Vitamin B_{12}?*

A. Corrin ring.

130. *What is the transport form of Vitamin B12?*

A. Methyl B12.

131. *What is the carrier of Vitamin B12 in blood?*

A. Transcobalamin-II, a glycoprotein, is the specific carrier.

132. *What is the storage form of Vitamin B12?*

A. It is stored in the liver cells, in combination with transcobalamin-I or transcorrin.

133. *What are enzymes using vitamin B_{12} as coenzyme?*

A. Methionine synthase and methyl malonyl CoA isomerase.

134. *What abnormalities are seen in Vitamin B_{12} deficiency?*

A. Megaloblastic anaemia, neurological manifestations methyl malonic aciduria. Homocysteinuria is also seen.

135. *In vitamin B_{12} deficiency, what are the abnormalities seen in urine?*

A. Urine may contain methyl malonic acid, homocysteine, cystathione, and formimino glutamic acid.

136. *What megaloblastic anemia is characterized by?*

A. It is a macrocytic hyperchromic anaemia. It is due to abnormal replication of DNA in hematopoietic tissue. It is due to direct insufficiency of folate or indirectly to a cobalamin insufficiency.

137. *What neurological manfestions are characterized by?*

A. Breakdown of myelin sheaths and interruption in nerve transmission leading to peripheral neuritis (numbness, tingling, and weakness of extremities). It includes also subacute combined degeneration of the spinal cord where both motor and sensory tracts are affected.

138. *Explain why giving folic acid does not treat macrocytic, anemia of B_{12} deficiency?*

A. This is because folic acid will correct the anemia, but it will worsen nervous manifestations.

139. *What abnormal compound is excreted in Vitamin B12 deficiency?*

A. Increased the excretion of methylmalonyl CoA in urine (= methylmalonyl aciduria) and Increased the excretion of Homocysteine (=Homocysteinuria).

140. *What is folate trap?*

A. The production of methyl THFA is an irreversible step. Therefore, the only way for generation of free THFA is methyl THFA to THFA, by a Vitamin B12 dependent step. When B_{12} is deficient, this reaction cannot take place. This is called the methyl folate trap.

141. *What is the clinical importance of folate trap?*

A. This leads to the associated folic acid scarcity in B12 deficiency.

142. *What is the explanation of demyelination in Vitamin B_{12} deficiency?*

A. *In Vitamin B_{12} deficiency, there is non-availability of active methionine. Therefore, methylation of phosphatidyl ethanolamine to phosphatidyl choline is not adequate. This leads to deficient formation of myelin sheaths of nerves.*

143. *What is the cause for pernicious anemia?*

A. *It is an autoimmune disease with a strong familial background. Antibodies are generated against intrinsic factor (IF). So IF is deficient, leading to defective absorption of B_{12}.*

144. *What is the difference in folate deficiency and B_{12} deficiency?*

A. In folate deficiency, there is macrocytic anemia, and in B12 deficiency, there are macrocytic anemia and neurological symptoms.

145. *Enumerate vitamins important for transmethylation.*

A. Folic acid in its active form and B_{12} (cobamides).

146. *What is the daily requirement of vitamin B12?*

A. One to two microgram / per day.

147. *A patient who has undergone gastrectomy is likely to develop deficiency of which vitamin?*

A. Vitamin B_{12}.

148. *Which is the Vitamin totally absent in plant sources?*

A. Vitamin B_{12}.

149. *Vitamin B_{12} is absorbed from where?*

A. Ileum.

150. *Enumerate vitamins synthesized by intestinal bacteria*

A. K1, biotin and B_{12}.

151. *Can the body utilize B_{12} synthesized in large intestine?*

A. No, because B_{12} is not absorbed through the mucosa of large intestine.

152. *Enumerate coenzymes derived from vitamins*

A. TPP, FMN, FAD, NAD^+, $NADP^+$, PLP, CoASH, Lipoic acid, Cobalamine, and vitamin C.

153. *What is the chemical structure of Vitamin C?*

A. L-ascorbic acid.

154. *How is it synthesised?*

A. Man and primates cannot synthesize ascorbic acids. Lower animals could synthesize it from glucose through glucoronic acid pathway.

155. *what are the major functions of ascorbic acid?*

A. Ascorbic acid promotes collagen formation through its action on posttranslational hydroxylation of proline and lysine residues into hydroxyproline and hydroxylysine residues.

156. *What are the other functions of ascorbic acid?*

A. Iron absorption from the intestine, reconversion of methemoglobin to hemoglobin, carnitine synthesis, catecholamine synthesis, steroid hormones synthesis, oxidation of parahydroxy phenyl pyruvate to homogentisic acid. Ascorbic acid acts as a specific reducing agent giving electrons to ferric ions, cupric ions and metal ions bound to various cytochromes and oxygen.

157. *Which vitamin is required for post-translational modifications?*

A. Ascorbic acid.

158. *What are vitamins act as antioxidant?*

A. E, A and C.

159. *What is the daily requirement of ascorbic acid?*

A. 75 mg / day.

160. *Scurvy is due to the deficiency of which vitamin?*

A. Ascorbic acid.

161. *How long vitamin C can be stored in the body?*

A. 3 months.

162. *What are deficiency manifestations of Scurvy?*

A. Bleeding into gum, muscles, joints, kidneys, gastrointestinal tract and pericardium (due to decrease collagen formation), behavioral change due to decrease neurotransmitters, severe emotional disturbances, general weakness (due to decrease carnitine and fatty acids oxidation).

163. *What are the important features of scurvy?*

A. Hemorrhagic tendency, microcytic anemia, bone pain, bleeding gums.

164. *What are vitamins alcoholic in nature?*

A. Vitamins A, D, E, C, B1, B2, B6, pantothenic acid and folic acid.

165. *What are sulfur containing vitamins?*

A. B_1, biotin and lipoic acid.

166. *What are sulfur containing coenzymes?*

A. TPP, biotin, CoASH, lipoic acid and glutathione (GSH).

167. *What are vitamins important for erythropoiesis?*

A. Folic acid and B_{12}.

168. *What is the importance of choline?*

A. (1) It enters in the formation of lecithin, plasmalogen, and sphingomyelin. (2) It has a lipotropic action i.e. it prevents fatty liver. (3) It enters in the formation of acetylcholine. (4) Oxidation of choline gives betaine. Betaine functions as a methyl donor in transmethylation reactions.

169. Explain why choline is not considered a vitamin?

A. Because it is needed in a relatively big amount, it can be formed in the body from serine, and it enters in the structure of tissues.

170. *What is the importance of inositol?*

A. It enters in the structure of phosphatidyl inositol → Inositol triphosphate → Second messenger for hormonal action.

171. *What is the importance of lipoic acid?*

A. It acts as coenzyme in decarboxylation of α-keto acid e.g pyruvate and α-ketoglutarate.

MCQ, Matching, true and false and Completion

Select and encircle the most appropriate answer or completion:

1. *Pyridoxal phosphate is a cofactor for which of the following enzymatic reaction?*
   A. Fixation of carbon dioxide.
   B. Oxidation-reduction.
   C. Transaminases.
   D. One carbon group transfer
   E. Decarboxylation of α-ketoacids.

2. *Which one of the following statements concerning vitamin E is INCORRECT?*
   A. Diet rich in vitamin E decreases the risk of heart diseases.
   B. It inactivates toxic oxygen superoxide and free radical.
   C. It removes peroxide formation in polyunsaturated fatty acids.
   D. Its deficiency usually occurs in premature infants.
   E. Long term deficiency leads to night blindness.

3. *Which one of the following statements concerning water soluble vitamins is INCORRECT?*
   A. Biotin functions as coenzyme for oxidative decarboxylation of α-keto acids.
   B. Pantothenic acid is a part of acyl carrier protein (ACP).
   C. Pyridoxal phosphate (PLP) is essential for heme metabolism.
   D. People who depend on corn in their diet may develop pellagra.
   E. Folate deficiency may accompany vitamin B12 deficiency due to complexity between the two vitamins.

4. *Vitamin K:*
   A. Is a water soluble vitamin.
   B. Vitamin K_2 is synthetic.
   C. Essential for clot formation.
   D. Present normally in the intestine of newborn infants.
   E. Long use of dicumarol promotes its action.

5. *Which one of the following statements concerning L-ascorbic acid is INCORRECT?*
   A. Dehydro –L-ascorbic acid is inactive form of vitamin C.
   B. It is cofactor in hydroxylation of proline and lysine.
   C. It is an antioxidant.
   D. Long term deficiency leads to scurvy.
   E. It acts as reducing agent and important for iron absorption.

6. *Which one of the following statements concerning niacin is CORRECT?*
   A. It is a coenzyme for carboxylation reactions.
   B. Is the precursor of FAD coenzyme.
   C. Its deficiency leads to Beri beri.
   D. It is essential for formation of the coenzymes NAD^+ and $NADP^+$.
   E. It is rich in maize.

7. *A deficiency of pyridoxal phosphate (PLP) may be accompanied by all the following EXCEPT::*
   A. Disturbance in amino acids metabolism.
   B. Convulsions in young infants.
   C. Pellagra.
   D. Scurvy.
   E. Microcytic, hypochromic anemia.

8. *Which one of the following statements concerning vitamin B12 is INCORRECT?*
   A. It is red in color.
   B. It is a cofactor for conversion of hmocysteine into methionine.
   C. It requires intrinsic factor for its absorption.
   D. Restrict vegetarians develops B12deficiency.
   E. It contains heme ring.

9. *Vitamin K plays a role in biosynthesis of:*
   A. collagen and elastin
   B. prothrombin and osteocalcin
   C. heparin and heparin sulfate
   D. prostaglandins and Leukotrienes
   E. Electron transport

10. Thiamine gives:
   A. T3 and T4
   B. CoA
   C. TPP
   D. PLP

11. *Carboxylation of pyruvate requires:*
   A. Thaimin pyrophosphate.
   B. B_{12}
   C. Pyrodixal phosphate.
   D. Biotin.
   E. Folic acid

12. *THFA is coenzyme for:*
   A. Trasport of amino group
   B. CO2 fixation
   C. Transport of methylene group
   D. Transport of oxygen

13. *Vitamin E acts as:*
   A. Anti-rickets
   B. Anti-scurvy
   C. Antibody
   D. Antioxidant

14. *Vitamin K is essential for:*
   A. Synthesis of prothrombin
   B. Synthesis of calcitonin
   C. Synthesis of serotonin
   D. Synthesis of catecholamines
   E. Iron absorption

15. *Vitamin B12 contains:*
   A. Iron
   B. Copper
   C. Zinc
   D. Selenium
   E. Cobalt

16. *In the regeneration of methionine from homocysteine, which of the following vitamin(s) or vitamin derivative(s) are involved:*
   A. Lipoic acid
   B. Retinoic acid
   C. Biotin and thiamine pyrophosphate
   D. Tetrahydrofolate and vitamin B12
   E. Vitamins E and K

17. *Which one of the following statements concerning vitamin D is CORRECT?*
   A. Hypocalemia causes direct activation of vitamin D.
   B. Hypophosphatemia causes indirect activation of vitamin D.
   C. Vitamin D deficiency causes osteomalacia in children.
   D. Calcitriol causes normalization of serum calcium by acting on bones, kidney and intestine.
   E. Vitamin D opposes the effect of parathyroid hormone.

18. *Biotin is coenzyme for:*
   A. Carboxylation reactions
   B. Transamination reactions
   C. Transmethylation reaction
   D. Decarboxylation reactions

19. *The disease pellagra is due to a deficiency of:*
   A. Vitamin B_2
   B. Biotin
   C. Pantothenic acid
   D. Folic acid
   E. Niacin

20. *Anti beriberi vitamin is:*
   A. Ribovlavin
   B. Thiamin
   C. Ascorbic acid
   D. Nicotonic acid

21. *Cobamides are coenzymes derived from:*
   A. Folic acid
   B. Vitamin C
   C. Vitamin B12
   D. Cobalt
   E. Nicotonic acid

22. *β-Carotene is converted to vitamin A in the:*
   A. Liver
   B. Intestine
   C. Spleen
   D. Adrenal cortex
   E. Adipose tissue

23. *Activation of vitamin D3 occurs in:*
A. Liver and intestine
B. Liver and kidney
C. Bone and intestine
D. Bone and kidney
E. Liver and bone

24. *Which one of the following statements concerning vitamin D is CORRECT:*
A. Chronic renal failure requires administration of 1,25 dihydroxycholecalciferol.
B. Vitamin D is required in the diet of individuals exposed to sunlight.
C. 25 Hydroxycholecalciferol is the active form of the vitamin.
D. Vitamin D opposes the effect of parathyroid hormone.
E. A deficiency of vitamin D results in an increased secretion in calcitonin.

25. *Skin disorders can occur in case of deficiency of:*
A. Niacin
B. Retinol
C. Vitamin K
D. Both niacin and retinol
E. Both Retinol and vitamin K

26. *The absorption of light by cells in the retina of the eye results in the conversion of:*
A. β-caroene to retinal.
B. Cis-retinal to all trans-retinal.
C. All trans-retinal to cis-retinal.
D. Retinal to retinol.
E. Retinol to retinal.

27. *Which of the following characterstics would be seen in a patient with a severe deficiency of thiamin:*
A. A decreased level of blood pyruvate and lactate.
B. An increased clotting time of blood.
C. A low hepatic cell transaminase activity.
D. A decreased level of transketolase activity in red blood cells.
E. A decreased level of blood calcium.

28. *Oxidative decarboxylation of pyruvate requires:*
A. Thiamine pyrophosphate
B. B_{12}
C. Pyrodixal phosphate.
D. Biotin.
E. Folic acid

29. *The vitamin which acts as co-carboxylase is:*
A. B_1
B. B_2
C. Niacin
D. Biotin
E. B_{12}

30. *Decarboxylation of glutamate requires:*
   A. Thaimin pyrophosphate.
   B. B_{12}
   C. Pyridoxal phosphate.
   D. Biotin.
   E. Folic acid

31. *Vitamin E is a substance that:*
   A. Produces rancidity
   B. Prevents rancidity
   C. Produces Hardening of oils
   D. Produces emulsification of oils

32. *Which of the following stimulates the synthesis of calcium binding protein in intestinal mucosa?*
   A. Calcium
   B. Calcitriol
   C. Calcitonin
   D. α Tocopherol
   E. Parathyroid hormone

33. *The four D's of dementia, diarrhea, dermatitis and death are associated with a deficiency of:*
   A. Vitamin A
   B. Vitamin B_{12}
   C. L-ascorbic acid
   D. Biotin
   E. Niacin

34. *The function of vitamin E is:*
   A. Antioxidant
   B. Anticoagulant
   C. Precursor of vitamin A
   D. Antidote for heparin

35. *All the following vitamins are fat soluble EXCEPT:*
   A. Vitamin A
   B. Vitamin C
   C. Vitamin D
   D. Vitamin E
   E. Vitamin K

36. *Vitamin B12:*
   A. is a fat soluble vitamin
   B. a vitamin not needed in diet because it is synthesized by intestinal bacteria.
   C. is a zinc containing B vitamin.
   D. Needs intrinsic factor for absorption
   E. present in animal and plant sources

37. *A vitamin that is acting as a reducing agent is:*
   A. Thiamin
   B. Vitamin B12
   C. Vitamin C
   D. Folic acid
   E. Biotin

38. *Whole grain cereals is an excellent source of:*
   A. Vitamin D
   B. Ascorbic acid
   C. Thiamine
   D. Vitamin A
   E. All of these

39. *Riboflavin is a constituent of:*
   A. Carboxylase
   B. Pantothenic acid
   C. NAD^+
   D. FAD

40. *Vitamin D is required for the prevention of:*
   A. Beriberi
   B. Scurvy
   C. Rickets
   D. Pellagra
   E. Night blindness

41. *Pellagra may result from the deficiency of the following EXCEPT:*
   A. Niacin
   B. Biotin
   C. Pyridoxal phosphate
   D. Tryptophan

In the following questions indicate with clear (T) the true statements, and with clear (F) the false statements:

In the synthesis of 1,25 dihydroxy D_3 from 7-dehyrocholesterol:

42. The second ring of steroid structure is cleaved
43. Parathyroid hormone is required
44. Ultraviolet light is required
45. Carbon 1 and 25 are hydroxylated in liver
46. May be derived from carotene pigment, present in carrots.

Vitamin A:

47. Is formed by the action of carotene dioxygenase on carotene
48. Has one provitamin, retinal.
49. Is essential for normal collagen synthesis.
50. Is essential for normal differentiation of epithelial cells.
51. Needs a binding protein for transportation in blood.

Vitamin K2:

52. Is fat soluble vitamin.
53. Can be synthesized by intestinal bacteria.
54. Anti-oxidant
55. Essential for synthesis of blood factors II, VII, IX and X.
56. Needs bile salts for absorption.

Matching: For each set of numbered questions, choose the ONE BEST answer from the list of lettered options below it. An answer may be used once or more times, or not at all.

57. *Transaminase.*
58. *Carboxylase.*
59. *Transketolase.*
60. *Isocitrate dehydrogenase.*
61. *Succinate dehydrogenase.*

A. *FAD*
B. *NAD^+*
C. *Ascorbic acid*
D. *Pantothenic acid*
E. *Biotin*
F. Thiamine diphosphate

62. *Pyridoxal phosphate(vitamin B_6)*
63. *Folic acid*
64. *Calcitriol*
65. *Biotin*
66. Thiamine (vitamin B_1)

A. *Synthesis of DNA*
B. *Hydroxylation of proline and lysine*
C. *Calcium metabolism*
D. *Pentose phosphate pathway*
E. *Decarboxylation of amino acids.*
F. *Carboxylation reactions*

67. *Required in oxidative decrboxylation*
68. *Contains a glutamate residues*
69. *Participates in the conversion of homocystein to methionine*
70. *A water soluble antioxidant*
71. *Decreases the risks for coronary artery disease in adults*

A. Biotin
B. Vitamin B12
C. Ascorbic acid
D. Thiamine
E. Folic acid
F. Vitamin E

72. *Scurvy*
73. *Osteomalcia*
74. *Beri beri*
75. *Pellagra*
76. *A precursor of a vitamin*

A. B- Carotene
B. Calcitriol
C. Ascorbic acid
D. Niacin
E. Thiamine

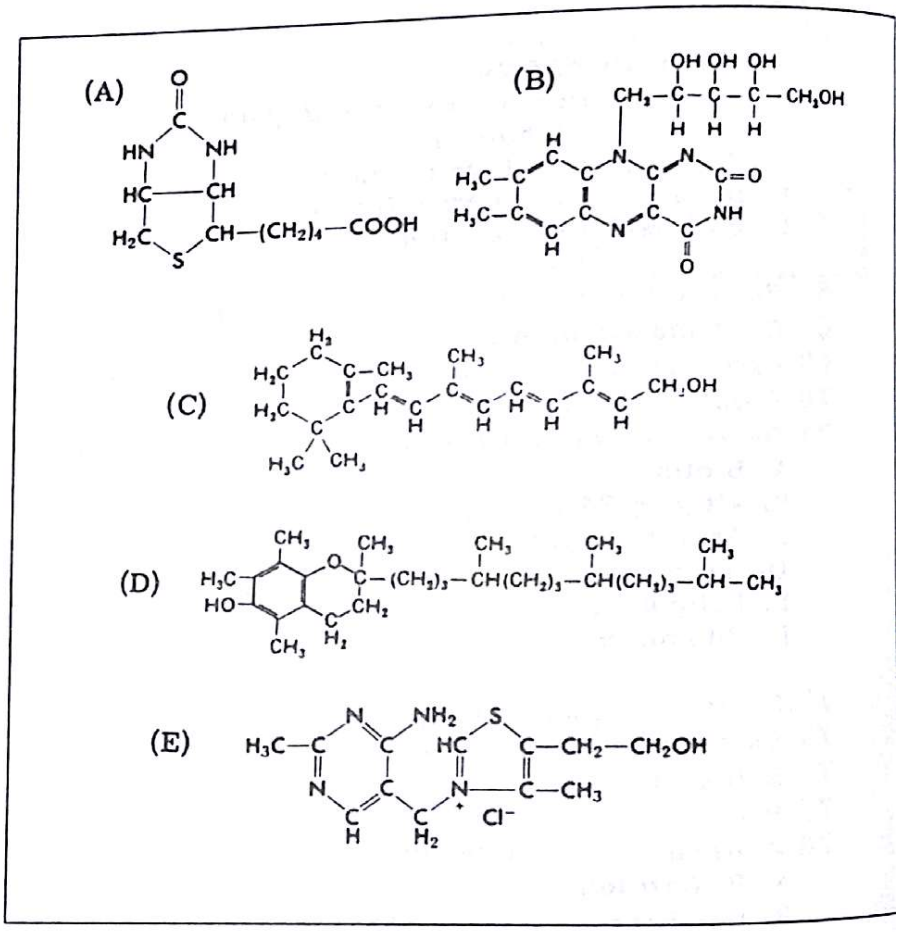
77. *Vitamin K*
78. *Vitamin B_{12}*
79. *Vitamin C*
80. *Pyridoxal phosphate*
81. *Retinal*

A. A vitamin that acts as a reducing agent
B. Coenzyme of transamination
C. Biosynthesis of prothrombin
D. A vitamin that is essential for night vision
E. Cobalt containing vitamin

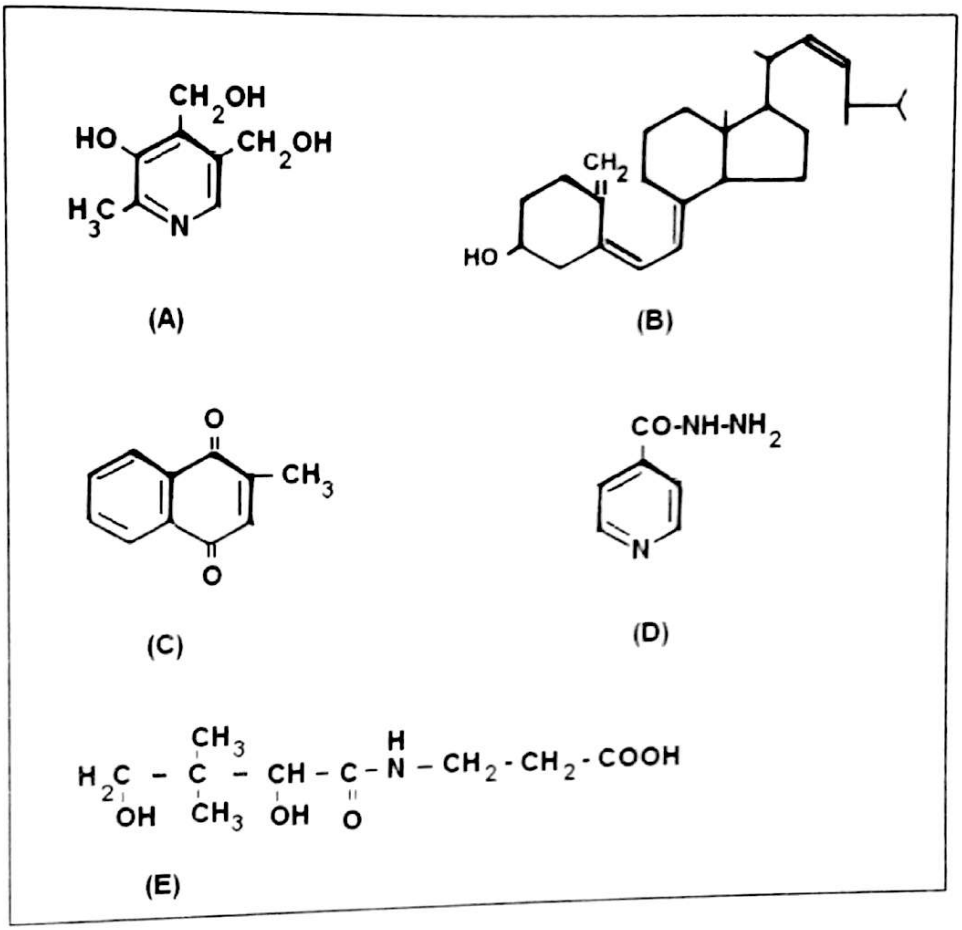
82. *Folic acid*
83. *1,25 dihydroxycholecalceferol*
84. *Vitamin K2*
85. *Retinal*

A. Rickets
B. Night blinndness
C. Prolonged clotting time
D. Macrocytic anemia

86. *Riboflavin*
87. Thiamine
88. *Biotin*
89. *α-Tocopherol*
90. *Retinol*



91. *Pyridoxine*
92. *Pantothenic acid*
93. *Menadione*
94. *Vitamin D*
95. *Isoniazid*



Answer Key

MCQ:

1	2	3	4	5	6	7	8	9	10
C	E	A	C	A	D	D	E	B	C
11	12	13	14	15	16	17	18	19	20
D	C	D	A	E	D	D	A	E	B
21	22	23	24	25	26	27	28	29	30
C	B	B	A	D	B	D	A	D	C
31	32	33	34	35	36	37	38	39	40
B	B	E	A	B	D	C	C	D	C
41									
B									

True and false:

42	43	44	45	46	47	48	49	50	51
T	T	T	F	F	T	F	F	T	T
52	53	54	55	56					
T	T	F	T	T					

Matching:

57	58	59	60	61	62	63	64	65	66
D	E	F	B	A	E	A	C	F	D
67	68	69	70	71	72	73	74	75	76
D	E	B	C	F	C	B	E	D	A
77	78	79	80	81	82	83	84	85	86
C	E	A	B	D	D	A	C	B	B
87	88	89	90	91	92	93	94	95	
E	A	D	C	A	E	C	B	D	

Chapter 5

Enzymes, Iso-Enzymes and Clinical Enzymology

1. *What are enzymes?*

   A. Enzymes are specific protein catalysts that accelerate the rate of chemical reactions.

2. *What are catalysts?*

   A. These are organic or inorganic substances that accelerate the rate of chemical reactions. The organic catalysts are enzymes but the inorganic catalysts are metals.

3. *What is Substrate?*

   A. It is the substance upon which the enzyme acts.

4. *What is rate of chemical reactions?*

   A. It is the change in the amount (moles or grams) of starting materials (substrates) or products per unit time.

5. *What is catalytic site?*

   A. This is the active site or substrate binding site. It is the site in enzyme that accommodates specifically and temporary the substrate during chemical reaction.

6. *What is unit of enzyme activity?*

   A. It is the amount of enzyme causing transformation of one micromole (1 umol) of a substrate per minute at 25° C under optimal conditions of measurement.

7. *What is enzyme specific activity?*

   A. Is the number of units of enzyme activity per milligram of enzyme protein.

8. *What is katal?*

   A. Is the amount of enzyme activity that transforms 1 mol of substrate per second.

9. *What is enzyme activation energy?*

   A. It is the amount of energy required to raise all the molecules in one mole of a substance to the transition state.

10. *What are the features of enzyme kinetics?*

    A. Enzymes lower activation energy. They increase the chemical reaction, but do not alter equilibrium of the reaction.

11. *How are enzymes classified?*

A. They are classified into six major classes. (1) Oxidoreductases, (2) transferases, (3) hydrolases, (4) lyases, (5) isomerases (6) ligases.

12. *What is the function of oxidoreductases?*

A. Transfer of hydrogen in oxidation-reduction reactions.

13. *How?*

A. S (oxidized) + Y (reduced) → S (reduced) + Y (oxidized).

14. *Give an example of oxidoreductases.*

A. Respiratory chain enzymes in mitochondria.

15. *What is the function of transferases?*

A. Transfer of groups other than hydrogen.

16. *Give examples of transferase.*

A. Transaminase and hexokinase.

17. *What is the function of hydrolases?*

A. Cleave bond after adding water.

18. *Give an example of a hydrolase.*

A. Peptidases.

19. *What is the function of lyases?*

A. Cleave bond without adding water.

20. *Which enzyme will add water to a double bond, without breaking the bond?*

A. Hydratase.

21. *Give an example of lyase.*

A. Aldolase.

22. *Compare between lyases and hydrolases:*

A. Lyases are enzymes catalyze the removal of groups from substrate by mechanism other than hydrolysis (e.g. decarboxylase). Hydrolase catalyzes hydrolysis i.e. breakdown of a chemical bond by addition of water e.g. peptidase.

23. *Give an example of isomerase.*

A. Phosphohexose isomerase.

24. *What is the function of ligases?*

A. Condensation of two molecules with hydrolysis of ATP.

25. *Give an example of ligases.*

A. glutamine synthetase.

26. *What is the difference between synthetase and synthase?*

A. Synthetases are ATP-dependent enzymes catalyzing synthetic reactions; they belong to ligases e.g. glutamine synthetase.

Synthases are enzymes catalyzing synthetic reactions; but they do not require ATP directly; they belong to transferases.

27. *Give an example of synthetases.*

A. Glutamine synthetase.

28. *Give examples of synthases.*

A. Glycogen synthase, carbamoyl phosphate synthase, and citrate synthase.

29. *What is holoenzyme?*

A. Some enzymes are conjugated proteins and they are called holoenzyme. They are consisted of protein part called apoenzyme and non-protein part called coenzymes.

30. *What are coenzymes?*

A. A coenzyme is a low molecular weight, non-protein, organic substance, which is essential for the biological activity of some enzymes. Without coenzyme, these enzymes cannot catalyze any reaction. Coenzyme accepts one of the products of the reaction.

31. *How are coenzymes classified?*

A. Those taking part in reactions catalyzed by oxidoreductases by donating or accepting hydrogen atoms or electrons and those coenzymes taking part in reactions transferring groups other than hydrogen.

32. *Compare between apoenzyme and coenzyme:*

	Apoenzyme	*Coenzyme*
Structure	Protein	Non-protein
Effect of heat	Heat labile	Heat stable
Molecular weight	High	Low
Dialysis;	Non dialyzable	Dialyzable

33. *Give some examples of coenzymes involved in oxidoreductases.*

A. NAD , NADP , and FAD.

34. *What is the full name of NAD?*

A. Nicotinamide adenine dinucleotide.

35. *What is FAD?*

A. Flavin adenine dinucleotide.

36. *Enumerate hydrogen carriers.*

A. FMN, FAD, NAD^+, $NADP^+$, glutathione, lipoic acid and coenzyme A.

37. *Enumerate electron carriers.*

A. These are usually the metals acting as prosthetic group for some

oxidoreductases. Fe^{+++} in cytochrome system, Cu^{++} for uricase, tyrosine hydroxylase and L-ascorbic acid oxidase.

38. *Give some examples of coenzymes involved in reactions other than hydrogen transfer.*

A. Thiamine pyrophosphate, pyridoxal phosphate, biotin, and coenzyme A.

39. *Give an account on properties of enzymes:*

A. They are invariably proteins. They act within a moderate pH and temperature range. They are highly specific, catalyzing only one type of chemical reaction. There are 6 types of specificity.

40. *What are types of enzyme specificity?*

A. Optical (stereo) specificity, group specificity, absolute specificity, relative specificity, reaction specificity, and dual specificity.

41. *What is optical specificity?*

A. Enzymes act on one of 2 isomers e.g. maltase acts on α-glycosides and not on β glycosides.

42. *What is group specificity?*

A. Enzymes need the presence of certain group to act e.g. pepsin acts on peptide bonds.

43. *Give an example for group specificity.*

A. Trypsin can hydrolyze peptide bonds formed by carboxyl groups of arginine or lysine residues.

44. *What is absolute specificity?*

A. One enzyme acts only on one substrate e.g. urease enzyme acts only on urea.

45. *Give an example for absolute specificity.*

A. Urea is the only substrate for urease.

46. *What is relative specificity?*

A. One enzyme acts on a group of compounds having the same type of bonds e.g. lipase enzymes act on different triacylglycerols.

47. *What is reaction specificity?*

A. There are six enzyme classes (see later). Each class has its own specific substrates.

48. *What is dual specificity?*

A. One enzyme acts on 2 different substrates e.g. isocitrate dehydrogenase enzyme acts on isocitrate and oxalosuccinate.

49. *What is the type of specificity of the following enzymes: urease, lipase, pepsin & maltase?*

A. Urease: Absolute specificity, lipase: relative specificity, pepsin:

group specificity, and maltase: optical specificity.

50. *What is enzyme-substrate complex theory?*

A. The enzyme combines with the substrate, to form an enzyme-substrate complex, which immediately breaks down to the enzyme and the product.

51. *What is Fischer's " key and lock" theory?*

A. It states that the three dimensional structure of the active site of the enzyme is complementary to the substrate. Thus, enzyme and substrate fit each other like a key and its lock.

52. *What is Koshland's "induced fit" theory?*

A. The enzyme changes shape upon binding the substrate, so that the conformation of substrate and enzyme protein are only complementary after the binding reaction.

53. *What is the active (catalytic) site of an enzyme?*

A. This is an area of the enzyme where catalysis occurs.

54. *What is meant by serine proteases?*

A. Proteases (proteolytic enzymes) having a serine residue at its active center.

55. *Give an example of a serine proteases.*

A. Trypsin, chymotrypsin, and thrombin.

56. *What is initial velocity (Vi)?*

A. It is the initial portion of the reaction where the increase in the concentration of the product is correlated constantly with time.

57. *What is Vmax?*

A. The initial velocity (rate) of a reaction is directly proportional to the amount of substrate present until it reaches a maximum point known as maximum velocity (Vmax), where any increase in substrate meets with no increase in velocity.

58. *What are factors affecting the rate of enzyme activity?*

A. Enzyme concentration, substrate concentration, end products, temperature, pH, and presence of activators or inhibitors.

59. *How can substrate concentration affect the rate of enzyme activity?*

A. Velocity of reaction is directly proportional to the concentration of the enzyme i.e. increase S concentration → increase the velocity of the reaction up to certain point after which no further increase of the velocity occurs (Vmax). The S concentration at ½ Vmax is constant for each enzyme, and is known as the Michaelis constant or Km.

60. *What is Km value?*

A. Substrate concentration (expressed in moles / L) that produces half maximum velocity.

61. *What does it indicate?*

A. It denotes that 50% of enzyme molecules are bound with substrate molecules at that particular substrate concentration.

62. *What is its significance?*

A. Km value is constant for an enzyme. Thus, its value is higher when the affinity to the substrate is low and vice versa.

63. *How can enzyme concentration affect the rate of enzyme activity.*

A. At low enzyme (E) concentration only few substrate (S) molecules form E-S complex, and the velocity of the reaction is low. As the enzyme concentration is increased, more S molecules form E-S complex and the velocity is increased. This is true up to certain point after which no further increase of the velocity occurs.

64. *What is the effect of temperature on enzyme velocity?*

A. The velocity of reaction increases when temperature is increased, reaches a maximum and then falls (Bell-shaped curve).

65. *Why it falls?*

A. When temperature is more than 50°C, heat denaturation and consequent loss of tertiary structure of protein occurs.

66. *What is the effect of pH on the activity of an enzyme?*

A. Each enzyme has an optimum pH, on both sides of which the velocity will be drastically reduced.

67. *What is the explanation for the effect of pH?*

A. The pH decides the charge on the amino acid residues at the active site. The net charge on the enzyme protein would influence substrate binding and catalytic activity.

68. *What is the optimum pH of usual enzymes?*

A. Usually enzymes have the optimum pH between 6 and 8.

69. *Are there any important exceptions for this general rule?*

A. Pepsin (optimum pH 1-2), alkaline phosphatase (optimum pH 9-10) and Acid phosphatase (4-5).

70. *How can end product affect the rate of enzyme activity.*

A. End product inhibits the first enzyme in the reaction.

71. *What are types of enzyme activators?*

A. Metal ions, enzymes, HCl and bile salts.

72. *Give example of metal ions as enzyme activators.*

A. Chloride ions, which activate salivary amylase and calcium ion, which activates activate blood clotting enzymes.

73. *Give example of enzymes acting as enzyme activators.*

A. Some inactive enzymes (zymogens) may need other enzymes for activation e.g. trypsinogen is activated by enteropeptidase.

74. *What is auto-activation? Give example*

A. Auto-activation means that the inactive enzyme (zymogen) is activated by small concentration of the enzyme itself e.g. pepsinogen is activated by pepsin, and trypsinogen is activated by trypsin.

75. *How can an inhibitor affect the rate of enzyme activity?*

A. The velocity of the reaction is inversely proportional to the concentration of the inhibitor.

76. *What are the different types of inhibitions of enzyme activity?*

A. Reversible inhibitors, which include competitive, noncompetitive and uncompetitive inhibitors, irreversible inhibitors and allosteric regulation.

77. *What are salient features of competitive inhibition?*

A. In competitive inhibition, (1) Both inhibitors and substrates have structural similarity (2) Both bind to the same site (catalytic site) (3) It is reversible. (4) Km is increased. (5) Vmax is not changed.

78. *Give an exmple of competitive inhibitors.*

A. Inhibition of succinate dehydrogenase by malonic acid.

79. *Give examples of clinical application of competitive inhibition.*

A. Sulfonamide inhibits PABA incorporation in bacteria, and so acts as an antibacterial agent. Methotrexate inhibits folate reductase system, dicoumarol inhibits vitamin K.

80. *What are salient features of non-competitive inhibition?*

A. In non-competitive inhibition, (1) No structural similarity between inhibitors and substrates (2) They bind to different sites (3) Km is unchanged. (4) Vmax is decreased.

81. *Give an exmple of non-competitive inhibitors.*

A. Oxidizing agent, heavy metals, di-isopropyl fluoro phosphate (inhibits trypsin), and fluoride (inhibits enolase).

82. *What is the mechanism of inhibitory action of Di-isopropyl fluorophosphate?*

A. It inhibits enzymes with serine in their active centers, e.g. acetylcholine esterase.

83. *Compare between feed back inhibition and feed back regulation of enzymes:*

A. (1) Feed back inhibition is the inhibition of series of enzymatic reactions by the end product. Usually the accumulated end product will inhibit the enzyme catalyzing the first reaction. (2) Feed back regulation is the inhibition of series of enzymatic reactions by the end product. Usually the accumulated end product will act as repressor inhibiting transcription of enzyme at nucleic acids levels.

84. *Define allosteric inhibitors:*

A. These are enzyme inhibitors that bind non-covalently to other site than catalytic site.

85. *What are the salient features of allosteric inhibition?*

A. (1) The inhibitor is not a substrate analogue. (2 It is partially reversible when excess substrate is added. (3) Km is usually increased. (4) Vmax is reduced. (5) Most allosteric enzymes posses quaternary structure. They are made up of subunits.

86. *What is the use of assessing the km value of an enzyme? What is the application?*

A. Determination of Km value is also useful to understand the natural substrate of an enzyme. Study of Km value will also differentiate the competitive and non-competitive inhibitions.

87. *What is zymogen?*

A. Zymogens are inactive enzymes e.g. pepsinogen.

88. *Why zymogens are inactive?*

A. Zymogens are inactive because a polypeptide chain masks their catalytic sites. Inactive zymogen is activated by removal of this polypeptide chain to open the catalytic site for its substrate.

89. *Give an example of how zymogen is activated.*

A. By removal of a small polypeptide from trypsinogen, the active trypsin is formed. This results in unmasking of the active centre.

90. *What is the significance of zymogen activation?*

A. Gastro-intestinal enzymes are synthesized in the form of zymogens, and only after secretion into the alimentary canal, they are activated. This prevents autolysis of cellular structural proteins. Coagulation factors are seen in blood as zymogen form, their activation takes place only when necessity arises. This prevents intravascular coagulation.

91. *Enumerate mechanisms that regulate enzyme activity.*

A. Amount of enzyme present, allosteric regulation, feed back inhibition, feed back regulation and covalent modification.

92. *What is allosteric regulation?*

A. These are substances (effectors) that act by combining non-covalently with certain sites present in some enzymes other than catalytic sites. These sites are called allosteric sites. The effectors are either positive (if they stimulate catalytic reactions) or negative if they inhibit them). Effectors may be the end product of metabolic pathway.

93. *Give examples for allosteric inhibition.*

A. ALA synthase and HMG CoA reductase.

94. *What is covalent modification?*

A. It means, either addition of a group to the enzyme protein by a covalent bond; or removal of a group by cleaving a covalent bond.

95. *Give some examples of covalent modification.*

A. Glycogen synthase is inactive, in the phosphorylated state, whereas it is active when dephosphorylated.

96. *Define enzyme repressors.*

A. These are substances (or metabolites) that repress (inhibit) enzyme synthesis by DNA.

97. *Define enzyme inducers:*

A. These are substances (or metabolites) that induce (stimulate) enzyme synthesis by DNA. Inducers may be substrates for enzymes. Inducers may also be compounds similar in structure to the substrates. These compounds are called gratuitous inducers.

98. *What is meant by induction?*

A. Induction is effected at the level of DNA. The inducer will relieve the repression on the operator site and will remove the block on the biosynthesis of the enzyme molecules.

99. *Give an example of induction.*

A. Induction of lactose-utilising enzymes in the bacteria when the media contains lactose in the absence of glucose.

100. *What are constitutive enzymes?*

A. Enzymes whose concentration in a cell is independent of inducer are called constitutive enzymes.

101. *What is repression?*

A. Repression acts at the gene level; the number of enzyme molecules is reduced in the presence of repressor molecule.

102. *Give an example of repression.*

A. Synthesis of ALA synthase, the key enzyme of heme synthesis, is repressed (inhibited) by the heme itself.

103. *Give examples of multi-enzyme complexes.*

A. Fatty acid synthase, pyruvate dehydrogenase, and α- ketoglutarate dehydrogenase.

104. What are isoenzymes?

A. Isoenzymes are fractions of one enzyme having the same catalytic activity, but differ in chemical and immunological structure.

105. How to differentiate isoenzymes?

A. Electrophoresis, heat stability, Km value, inhibitor specificity, and tissue localization.

106. *Which is a functional enzyme in plasma?*

A. They are actively secreted into plasma, and have some functions in the blood. For example, enzymes of blood coagulation.

107. *What is non-functional enzymes in plasma?*

A. These are enzymes coming out from cells due to normal wear and tear.

108. *What is their clinical significance?*

A. Their normal levels in blood are very low, but are drastically increased during cell death (necrosis) or disease. Therefore, assays of these enzymes are very useful in diagnosis of diseases.

109. *Enumerate enzymes of medical importance.*

A. Transaminases (ALT and AST), alkaline phosphatase, acid phosphatase, lactate dehydrogenase (LD), amylase, lipase, creatine kinase (CK), gamma-glutamyl transferase (GGT), cholinesterase.

110. *What are types of cholinesterase?*

A. There are 2 types of enzyme; plasma cholinesterase that is known as pseudocholinesterase and tissue cholinesterase that is known as true cholinesterase.

111. *What are enzymes used for diagnosis of myocardial infarction?*

A. Creatine kinase (CK), aspartate aminotransferase (AST), and lactate dehydrogenase (LDH).

112. *What are proteins used for diagnosis of myocardial infarction?*

A. Myoglobin, cardiac troponin I (CTI), creatine kinase (CK), aspartate aminotransferase (AST), and lactate dehydrogenase (LDH).

113. *Lactate dehydrogenase has how many polypeptide subunits?*

A. Four. It is a tetramer.

114. Lactate dehydrogenase has how many isoenzymes?

A. Five.

115. *What are lactate dehydrogenase isoenzymes?*

A. LD1 (H4), LD2 (H3M), LD3 (H2M2), LD4 (M3H) and LD5 (M4) varaities, forming five isoenzymes. All these five forms are seen in all persons.

116. *How do you separate LDH isoenzymes in laboratory?*

A. By cellulose acetate electrophoresis at pH 8.6.

117. *LDH level in blood is increased in which conditions?*

A. Myocardial infarction, hemolytic anemias, muscular dystrophy, carcinomas, leukemias, and any condition which causes necrosis of body cells.

118. *Which LDH isoenzyme is increased in myocardial infarction?*

A. LDH-1 (H4).

119. *Creatine kinase (CK) level in serum is increased in which conditions?*

A. Myocardial infarction, muscular dystrophies.

120. *What is the advantage of CK estimation over LDH estimation to identify myocardial infarction?*

A. The CK level starts to rise within three hours of infarction. Therefore, CK estimation is very useful to detect early cases, where ECG changes may be ambiguous. The CK level is not increased in hemolysis or in congestive cardiac failure; and therefore CK has an advantage over LDH.

121. *What are the isoenzymes of CK?*

A. CK is a dimmer with 2 subunits B and M, (B for brain and M for muscle). Therefore, three isoenzymes are possible (BB, MM, and MB).

122. *What are the origins of the CK isoenzymes?*

A. 80% of molecules in circulation are MM (CK3) variety of skeletal origin, 5% in circulation are MB(CK2) from heart, 1% from brain (BB or CK1) and 15% CKmt from mitochondria.

123. *When do you estimate total CK and the isoenzymes?*

A. Estimation of total CK is employed in muscular dystrophies and CK-MB isoenzyme is estimated to identify myocardial infarction.

124. *What is the advantage of cardiac troponin I over other parameters to identify the myocardial infarction?*

A. Cardiac troponin I (CTI) is released into the blood within four hours after the onset of cardiac symptoms, peaks at 12-16 hours and remains elevated for 5-9 days post-infarction. Therefore, CTI is very useful as a marker at any time interval after the heart attack. It is 75% sensitive index for myocardial infarction.

125. *What is the significance of AST?*

A. It is significantly elevated in myocardial infaction and moderately elevated in liver diseases.

126. *What is the significance of ALT?*

A. Very high values are seen in acute hepatitis. Rise in ALT levels may be noticed several days before clinical signs such as jaundice are manifested. Moderate increase may be seen in chronic liver diseases such as cirrhosis, and malignancy in liver.

127. *Alkaline phosphatase level in serum is elevated in which conditions?*

A. Moderate increase is seen in hepatic diseases (infective hepatitis, alcoholic hepatitis). High levels may be noticed in obstructive jaundice or cholestasis. Very high levels are seen in bone diseases such as Paget's disease, rickets, osteomalacia, osteoblastoma, metastatic carcinoma of bone.

128. *For alkaline phosphatase, how many isoenzymes are present?*

A. Six.

129. *What is Regan isoenzyme?*

A. It is the isoenzyme of alkaline phosphatase, inhibited by phenylalanine. It is of placental origin. It is elevated in about 15% cases of carcinoma of lung, liver, and gut and then named as Regan isoenzyme or carcinoplacental isoenzyme.

130. *Estimation of gamma glutamyl transferase (GGT) is useful to detect which condition?*

A. Alcohol abuse and obstructive liver disease.

131. *It is said that GGT is a better index of obstructive liver disease than alkaline phosphatase (ALP), why?*

A. ALP level is increased in both liver and bone diseases, but GGT is only in liver diseases.

132. *What are the enzymes useful in diagnosing liver pathology?*

A. ALT, AST, ALP, and GGT.

133. *Give the clinical implications of these enzymes.*

A. In infective hepatitis, ALT and AST levels are increased; in alcohol abuse, GGT level is increased; in obstructive jaundice, ALP and GGT levels are increased.

134. *Serum acid phosphatase level is increased in which condition?*

A. Prostate carcinoma.

135. *Total acid phosphatase may increase in some other conditions also; what are they?*

A. Prostate carcinoma, secondary metastasis in bones, per rectal examination, intra-vascular hemolysis.

136. *In such conditions, isoenzyme study is helpful or not?*

A. Yes, tartarate labile isoenzyme is specific for prostate carcinoma.

137. *What is the advantage of prostate specific antigen (PSA)?*

A. PSA is very specific for prostate carcinoma.

138. *What are the enzymes useful as tumour markers?*

A. Regan iso-enzyme of ALP for lung tumor; tatarate labile iso-enzyme of ACP and prostate specific antigen (PSA) for prostate carcinoma; Neuron specific enolase (NSE) for cancers of neuro-endocrine origin.

139. *Pseudo-cholinesterase deficiency is manifested as what?*

A. Succinyl choline apnea; prolonged apnea when succinyl choline is given as anesthetic drug.

140. *Which enzyme deficiency is inherited as X-linked?*

A. Glucose-6-phosphate-dehydrogenase.

141. *How the deficiency of GPD is manifested?*

A. Drug induced hemolytic anemia (favism).

142. *Acute pancreatitis can be diagnosed by estimating which enzymes?*

A. Amylase and lipase.

143. *Name some enzymes that are used as therapeutic agents.*

A. Asparaginase for leukemia, streptokinase to dissolve clots, and pepsin for indigestion.

144. *Compare between lysosomes and lysozymes.*

A. Lysosomes are cellular organelles that contain cathepsin enzymes, which is responsible of old cells lysis. Lysozymes are enzymes present in tears, saliva and other body secretion. They cause lysis of bacteria (bactericidal).

145. *What are cathepsins.*

A. Cathepsins are cellular enzymes present in lysosomes. They disintegrate cellular proteins by a process called autolysis. These enzymes are active only after death, as they need acidic pH, which is provided by lactic acid, and other acids liberated by dead tissues. Autolysis occurs also during life in case of involution of uterus after labor. Cathepsins also are highly active in certain types of cancers as in breast cancers. They facilitate spread of cancer cells to surrounding tissues and blood.

146. ***What is enzyme compartmentation?***

A. This means that enzymes are present inside each cell within isolated compartments, i.e. inside the nucleus, mitochondria, lysosomes or other compartments. This will enable reactions catalyzed inside one compartment to proceed without interference by enzymes present in the other compartments.

MCQ, Matching, true and false and Completion

Select and encircle the most appropriate answer or completion:

1. *A zymogen is:*
   A. Isoenzyme
   B. Anti-enzyme
   C. Enzyme precursor
   D. Enzyme inhibitor
   E. Enzyme activator

2. *The enzyme that hydrolyzes sucrose is:*
   A. Amylase
   B. Maltase
   C. Invertase
   D. Lactase

3. *Ligase enzymes:*
   A. Catalyze changes within one molecule
   B. Join two adjacent substrate using high energy phosphate
   C. Catalyze the hydrolysis of a substrate
   D. Transfer functional group
   E. Catalyze the Interconversion of one isomer into another

4. *In competitive inhibition:*
   A. The concentration of active enzyme molecules is reduced.
   B. Vmax is increased
   C. Vmax is decreased
   D. Km is increase
   E. Km is decreased

5. *An enzyme catalyzing the reaction: Lecithin + Cholesterol → Cholesterol ester + Lysolecithin may be classified as:*
   A. Oxidoreductase
   B. Ligase
   C. Hydrolase
   D. Transferase
   E. Lyase

6. *All of the following are characters of enzymes EXCEPT:*
   A. Specific carbohydrate catalysts
   B. They do not affect the equilibrium constant
   C. Highly specific
   D. Enzyme structures are not affected by entering the reaction
   E. May be synthesized as zymogen

7. *Isoenzyme is:*
   A. Inactive form of enzyme
   B. Enzymes that need the presence of certain group to act
   C. Unit of enzyme activity
   D. Fractions of enzyme, having the same catalytic activity but differ in chemical and immunological structure
   E. Inorganic substances that accelerate the rate of chemical reactions.

8. *Zymogen is:*
   A. Inactive form of enzyme
   B. Enzymes that need the presence of certain group to act
   C. Unit of enzyme activity
   D. Fractions of enzyme, having the same catalytic activity but differ in chemical and immunological structure
   E. Inorganic substances that accelerate the rate of chemical reactions.

9. *The amount of enzyme causing transformation of one micromole of substrate per minute at 25° C under optimal conditions of measurement is:*
   A. Katal
   B. Unit of specific enzyme activity
   C. Unit of enzyme activity
   D. Km

10. *A substrate concentration that produces half maximum velocity:*
   A. Km
   B. Katal
   C. Vmax
   D. Km/Vmax
   E. 1/Vmax

11. *Level of the following cmpounds is increased in myocardial infarction EXCEPT:*
   A. Lactate dehydrogenase.
   B. L-Glutamate dehydrogenase.
   C. Myoglobin
   D. AST
   E. Creatine kinase.

12. *The Michaelis constant (km) is:*
   A. A substrate concentration that produces maximum velocity.
   B. A substrate concentration that produces half maximum velocity.
   C. A measure of equilibrium between active and inactive enzymes
   D. A fixed true constant that is not changed from one substrate to another

13. *In non-competitive inhibition:*
   A. V_{max} is decreased
   B. The inhibitor competes with the substrate for the catalytic site
   C. Km is decreased
   D. Km is increased

14. *The concept of induced fit theory means that:*
   A. Enzyme-substrate complexes are formed only in oxidation-reduction reactions.
   B. The configuration of the substrate is altered to fit the active site.
   C. D- and L- isomers of an optically active substrate react at identical rates.
   D. The active site is flexible; the reactive groups of the enzyme are brought into proper alignment by the substrate.
   E. The lock and key theory of enzyme action adequately describes enzyme action.

15. *A competitive inhibitor for the succinate dehydrogenase is:*
   A. Malonate
   B. Arsenite
   C. Cyanide
   D. Malate
   E. Flouride

16. *Allosteric inhibitors act on:*
   A. Catalytic site of enzymes
   B. Other sites than catalytic site
   C. Both of them
   D. None of them

17. *If a coenzyme is required in an enzymatic reaction, it usually functions to:*
   A. Accept one of the cleavage products.
   B. Enhance the specificity of the apoenzyme.
   C. Increase the active sites of the apoenzyme.
   D. Activate the substrate.
   E. All of the above.

18. *Enzymes catalyze joining of two substrates using the energy released in the hydrolysis of high energy phosphate compound are:*
   A. Oxidoreductases
   B. Transferases
   C. Hydrolases
   D. Lyases
   E. Isomerases
   F. Ligases

19. *Enzymes catalyze an oxidation-reduction reaction between two substrates are:*
   A. Oxidoreductases
   B. Transferases
   C. Hydrolases
   D. Lyases
   E. Isomerases
   F. Ligases (or synthetases)

20. *Enzymes catalyze the transfer of a group other than hydrogen from one substrate to another:*
   A. Oxidoreductases
   B. Transferases
   C. Hydrolases
   D. Lyases
   E. Isomerases
   F. Ligases (or synthetases)

21. *Enzymes catalyze hydrolysis i.e. breakdown of a chemical bond by addition of water:*
   A. Oxidoreductases
   B. Transferases
   C. Hydrolases
   D. Lyases
   E. Isomerases
   F. Ligases (or synthetases)

22. *Enzymes catalyze removal of groups from substrates by mechanism other than hydrolysis:*
   A. Oxidoreductases
   B. Transferases
   C. Hydrolases
   D. Lyases
   E. Isomerases
   F. Ligases (or synthetases)

23. *Enzymes catalyze the interconversion of L- isomer into D- isomer:*
   A. Oxidoreductases
   B. Transferases
   C. Hydrolases
   D. Lyases
   E. Isomerases
   F. Ligases (or synthetases)

24. *Vmax is:*
   A. Initial velocity
   B. Maximal velocity
   C. Enzyme concentration
   D. Coenzyme concentration
   E. Substrate concentration

25. *In noncompetitive inhibition of enzymes Km is:*
   A. Increased
   B. decreased
   C. Same
   D. Doubled

26. *Optimum pH of pepsin is:*
   A. 2
   B. 5
   C. 6
   D. 7
   E. 8

27. *Malonic acid is a competitive inhibitor for:*
   A. Choline esterase enzyme
   B. Sucinate dehydrogenase
   C. Peroxidase
   D. Carbonic anhydrase

28. *An enzyme that removes electrons from substrate is termed:*
   A. Oxidoreductases
   B. Transferases
   C. Hydrolases
   D. Lyases
   E. Isomerases
   F. Ligases (or synthetases)

29. *Regulation of enzyme activity is achieved by the following EXCEPT:*
   A. Feed back inhibition
   B. Feed back regulation
   C. Presence of isoenzyme
   D. Phosphorylation dephosphorylation modification
   E. Allosteric regulation

30. *Autolysis is:*
   A. Enzyme activation
   B. Enzyme inhibition
   C. Breakdown of dead cells by cathepsins
   D. Breakdown of enzymes.

31. *Pick the WRONG STATEMENT about lactate dehydrogenase:*
   A. It has three isoenzymes
   B. It is a tetramer
   C. It reversibly converts pyruvate to lactate
   D. Its LD1 isoenzyme increased in myocardial infarction
   E. Its LD5 isoenzyme increased in liver cirrhosis

32. *Urea produced by urease enzyme is example of:*
   A. Relative specificity.
   B. Absolute specificity.
   C. Reaction specificity.
   D. Optical specificity.
   E. Group specificity.

33. *Lactate dehydrogenase (LDH) is composed of 4 polypeptide chains. How many isoenzymes does this enzyme possess?*
   A. 2
   B. 3
   C. 4
   D. 5
   E. 6

34. *Aldolase is classified as:*
   A. Isomerase
   B. Transferase
   C. Lyase
   D. Ligase
   E. Hydrolase

35. *For allosteric effects:*
   A. There is structural similarity between effectors and substrates
   B. The allosteric site of an enzyme is different from its substrate binding site.
   C. The allosteric effectors cause denaturation of enzyme.
   D. Allosterically controlled enzymes are not key enzyme.
   E. Allosteric enzymes are always dimers.

In the following questions indicate with clear (T) the true statements, and with clear (F) the false statements:

Related to regulation of enzyme activity:

36. Feed back inhibition is performed by one of intermediates of pathway.
37. Mechanisms of feed back inhibition and feed back regulation is the same.
38. Allosteric regulation is performed through catalytic site.
39. Phosphorylation of enzymes results always in inhibition of enzyme activity.
40. Amount of enzyme present depends on rate of enzyme synthesis (induction and repression).

For competitive inhibitors:

41. Both inhibitors and substrates have structural similarity
42. Both inhibitors and substrates bind to the same catalytic site
43. It is irreversible.
44. Km is increased.
45. Vmax is decreased.

For noncompetitive inhibitors:

46. Both inhibitors and substrates have structural similarity
47. Both inhibitors and substrates bind to different catalytic site
48. Km is increased.
49. Vmax is decreased.
50. Heavy metals are noncompetitive inhibitors

Matching: For each set of questions, choose the ONE BEST answer from the list of lettered options below it. An answer may be used once or more times, or not at all.

51. *CK-MB*
52. *Alkaline phosphatase.*
53. *Amylase.*
54. *Gamma glutamyl transferase*
55. *Acid phosphatase.*

A. Rickets.
B. Cancer prostate.
C. Myocardial infarction.
D. Pancreatitis.
E. Chronic alcoholism

56. $2\ H_2O_2 \rightarrow 2H_2O + O_2$
57. $H_2O_2 + A\ H_2 \rightarrow 2\ H_2O + A$
58. $AB + H_2O \longleftrightarrow AH + BOH$
59. $AH_2 + B \longleftrightarrow A + BH_2$

A. Hydrolases
B. Dehydrogenases
C. Catalase
D. Peroxidase

60. *Hepatic cirrhosis.*
61. *Bone diseases.*
62. *Myocardial infarction*
63. *Prostate carcinoma.*
64. *Chronic alcoholism.*
65. *Acute pancreatitis.*

A. *GGT*
B. ALT
C. *CPK*
D. Acid phosphatase
E. *Alkaline phosphatase*
F. lipase.

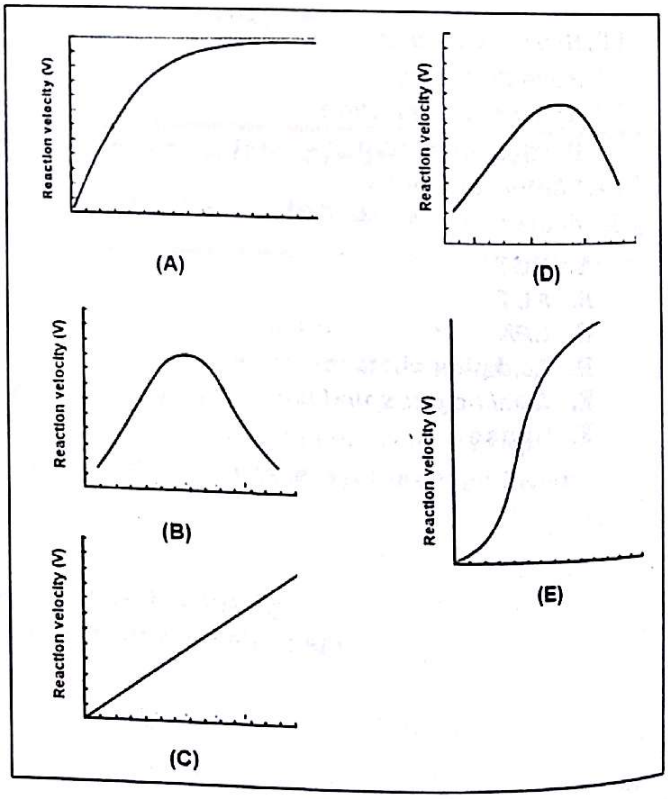
66. *Transaminase*
67. *Peptidase*
68. *Mixed function oxidase*
69. *Glutamine synthetase*
70. *Aldolase*
    A. Lyase
    B. Hydrolase
    C. Transferase
    D. Oxidoreductase
    E. Ligase

71. *Enzymes act on one of 2 isomers.*
72. *Enzymes need the presence of certain group to act.*
73. *One enzyme acts only on one substrate.*
74. *One enzyme acts on a group of compounds having the same type of bonds.*
    A. Relative specificity.
    B. Absolute specificity.
    C. Reaction specificity.
    D. Optical specificity.
    E. Group specificity.
    F. Dual specificity.

75. *Catalyzes the transfer of a group other than hydrogen from one substrate to another.*
76. *Catalyzes the breakdown of chemical bond by addition of water.*
77. *Catalyzes the removal of groups from substrates by mechanism other than hydrolysis.*
78. *Catalyzes the inter-conversion of one isomer into the other.*
79. *Catalyzes the oxidation reduction reactions between 2 substrates.*
    A. Oxidoreductase
    B. Hydrolase
    C. ligases
    D. Lyases
    E. Transferase
    F. Isomerase

Match the numbered items with the lettered curves in the graph as they best fit together:

80. *Enzymes concentration.*
81. *Substrate concentration.*
82. *Substrate concentration in the presence of allosteric inhibitor*
83. *pH.*
84. *Temperature*



Answer Key

MCQ:

1	2	3	4	5	6	7	8	9	10
C	C	B	D	D	A	D	A	C	A
11	12	13	14	15	16	17	18	19	20
B	B	A	D	A	B	A	F	A	B
21	22	23	24	25	26	27	28	29	30
C	D	E	B	C	A	B	A	C	C
31	32	33	34	35					
A	B	D	C	B					

True and false:

36	37	38	39	40	41	42	43	44	45
T	F	F	F	T	T	T	F	T	F
46	47	48	49	50					
F	T	F	T	T					

Matching:

51	52	53	54	55	56	57	58	59	60
C	A	D	E	B	C	D	A	B	B
61	62	63	64	65	66	67	68	69	70
E	C	D	A	F	C	B	D	E	A
71	72	73	74	75	76	77	78	79	80
D	E	B	A	E	B	D	F	A	C
81	82	83	84						
A	E	B	D						

Chapter 6 *Nucleotide Chemistry*

1. *What is a nucleotide?*

   A. Nitrogenous base + sugar + phosphate.

2. *What is a nucleoside?*

   A. Nitrogenous base + sugar.

3. *What are sugars present in nucleic acids?*

   A. Ribose in RNA and deoxyribose in DNA.

4. *What are the bases present in nucleotides?*

   A. Purines and pyrimidines.

5. *Name the common purines.*

   A. Adenine and guanine.

6. *Name the common pyrimidines.*

   A. Cytosine, uracil, and thymine.

7. *What are the bases present in DNA?*

   A. Adenine, guanine, cytosine, and thymine.

8. *Which nitrogenous base is absent in DNA?*

   A. Uracil.

9. *Which base is found exclusively in DNA and not in RNA?*

   A. Thymine.

10. *Which base is found exclusively in RNA and not in DNA?*

    A. Uracil.

11. *What are free nucleotides of biological importance?*

    A. They include adenosine derivatives, guanosine derivatives, cytidine derivatives, uridine derivatives and coenzymes.

12. *What are adenosine derivatives of biological importance?*

    A. ATP, Cyclic AMP (cAMP), S-Adenosyl methionine and Adenosine 3' –phosphate 5' – phosphosulfate (active sulfate).

13. *What are the functions of ATP?*

    A. ATP is a stored form of energy and it is used as a source of adenine nucleotides for nucleic acids synthesis.

14. *What are uses of energy derived from ATP?*

A. Muscle contraction, nerve conduction, absorption, secretion, active transport across cell membrane, activation of some compounds (glucose to form glucose-6-phosphate), synthesis of cyclic AMP and active methionine.

15. *What are the functions of cyclic AMP (cAMP)?*

A. cAMP acts as second messenger for some hormones. It is involved in regulation of carbohydrate and lipid metabolism.

16. *What are gaunosine derivatives of biological importance?*

A. GTP and Cyclic GMP (cGMP).

17. *What are the functions of GTP?*

A. It is used as a source of energy. It is a source of guanine nucleotides for nucleic acids synthesis.

18. *What are the functions of Cyclic GMP (cGMP)?*

A. Acts as a second messenger for some hormones (natriuretic factor).

19. *What are cytidine derivatives of biological importance?*

A. CTP.

20. *What are the functions of CTP?*

A. Is required for the biosynthesis of some phospholipids. It is a source of cytosine nucleotides for nucleic acids synthesis.

21. *What are uridine derivatives of biological importance?*

A. UDP-glucose, UDP-glucuronic acid and UDP-glucosamine.

22. *What are the functions of UDP-glucose?*

A. UDP-Glucose and UDP-galactose are used in synthesis of lactose, glycogen and glycolipids.

23. *What are the functions of UDP-glucuronic acid?*

A. Synthesis of glycosaminoglycans (GAGs), and in conjugation reactions (e.g. conjugation with bilirubin).

24. *What are the functions of UDP-sugar amines?*

A. UDP-glucosamine, UDP N-acetylglucosamine and UDP-N-acetyl-galactosamine are used in the synthesis of many compounds in the body e.g. glycoproteins, glycolipids and GAGs.

25. *What are the functions of S-adenosyl methionine?*

A. Methyl donor in transmethylation reactions.

26. *What are the functions of Adenosine 3' –phosphate 5' – phosphosulfate (active sulfate)?*

A. It acts as sulfate donor for the formation of sulfated proteoglycans. It acts also as sulfate donor for metabolites of

some drugs, which excreted in urine as sulfate conjugates.

27. *What are coenzyme nucleotides of biological importance?*

A. NAD^+, $NADP^+$, FAD and FMN

28. *What are the functions of NAD^+ and $NADP^+$?*

A. Hydrogen carriers.

29. *What are the functions of FAD and FMN?*

A. Hydrogen carriers.

30. *What are types of RNA?*

A. 3 types: mRNA, rRNA and tRNA:

31. *What are the functions of mRNA?*

A. mRNA carriers the genetic information from DNA in the nucleus to the ribosome (in cytosol) where protein biosynthesis occurs.

32. *What are the functions of rRNA?*

A. Ribosomes are the site of protein synthesis. They contain enzymes needed for protein biosynthesis.

33. *What are the functions of tRNA?*

A. tRNA acts as a carrier for amino acids from the cytosol to ribosomes where protein biosynthesis occurs. Each amino acid has one or more specific tRNA.

34. *Compare between DNA and RNA*

	DNA	*RNA*
Site	• Nucleus and mitochondria	• Cytosol
Functions	• Replication of DNA (cell division) • Transcription of mRNA	• Protein biosynthesis.
Structure	• Polynucleotides contain: Bases : Adenine, guanine, cytosine and thymine • Sugar: deoxyribose • Phosphate.	• Polynucleotides contain: Bases : Adenine, guanine, cytosine and uracil • Sugar: ribose • Phosphate.
Types	• One type.	•3 Types Messenger RNA Transfer RNA Ribosomal RNA
Number of strands	• 2 Strands in the form of double helix	• One strand only

MCQ, Matching, True and False and Completion

Select and encircle the most appropriate answer or completion:

1. *Which of the following nucleic acid bases is found in mRNA but not in DNA?*
   A. Adenine.
   B. Cytosine.
   C. Guanine.
   D. Thymine.
   E. Uracil.

2. *Which of the following nucleic acid bases is found in DNA but not in RNA?*
   A. Adenine.
   B. Cytosine.
   C. Guanine.
   D. Thymine.
   E. Uracil.

3. *The two strands of DNA double helix:*
   A. Are connected together by phosphate diester bonds.
   B. Are connected together by hydrogen bonds.
   C. Are connected together by disulfide bonds.
   D. Cannot be separated.

4. *Hydrolysis of ATP yields all the following EXCEPT:*
   A. Adenine
   B. Ribose
   C. Phosphate
   D. Nicotinic acid

5. *Nucleic acids are formed of nucleotides that are linked together by:*
   A. Hydrophobic bonds
   B. Phosphodiester bonds
   C. Peptide bonds
   D. Disulfide bonds

6. *Ribosomal RNA is present in:*
   A. Golgi apparatus
   B. Rough endoplasmic reticulum
   C. Mitochondria
   D. Lysosomes

7. *The sugar present in DNA is:*
   A. Ribose
   B. Ribulose
   C. Deoxyribose
   D. Glucose

8. *The sugar present in ATP is:*
   A. Sorbitol
   B. Ribulose
   C. Deoxyribose
   D. Glucose
   E. Ribose

9. *The enzyme responsible for synthesis of cyclic AMP is:*
   A. Adenine deaminase
   B. Adenosine triphosphatase
   C. Adenylate cyclase
   D. Phosphodiesterase

10. *The enzyme responsible for breakdown of cyclic AMP is:*
   A. Adenine deaminase
   B. Adenosine triphosphatase
   C. Adenylate cyclase
   D. Phosphodiesterase

11. *The substrate for adenylate cyclase is:*
   A. AMP
   B. ATP
   C. ADP
   D. GTP

12. *Removal of phosphate from AMP will produce:*
   A. Adenosine
   B. Adenine
   C. ATP
   D. ADP

13. All the following about S-adenosyl methionine are correct EXCEPT:
   A. Is formed by L-methionine adenosyl transferase
   B. The sugar obtained by hydrolysis is deoxyribose
   C. It acts as methyl donor
   D. It contains adenine base

14. *All the following about B-form of helical structure of DNA are correct EXCEPT:*
   A. It is left handed helical structure
   B. One turns span equal 3.4 nm
   C. Number of base pair (bP) per turn is 10.4
   D. The diameter of molecule is 2 nm
   E. It contains 2 grooves, minor and major

15. *FAD and FMN are coenzymes derived from:*
   A. Ribflavin
   B. Niacin
   C. Thiamin
   D. Biotin

16. *Hydrolysis of FAD yields all the following EXCEPT:*
   A. Flavin
   B. Adenine
   C. Phosphate
   D. Ribose
   E. Deoxyribose

17. *Hydrolysis of NAD^+ yields all the following EXCEPT:*
   A. Nicotinamide
   B. Adenine
   C. Flavin
   D. Phosphate
   E. Ribose

18. *The alcohol derived from hydrolysis of FAD is:*
   A. Glycerol
   B. Ribitol
   C. Sorbitol
   D. Mannitol

19. *The coenzyme that contains 3 phosphate groups is:*
   A. NAD^+
   B. $NADP^+$
   C. FAD
   D. FMN

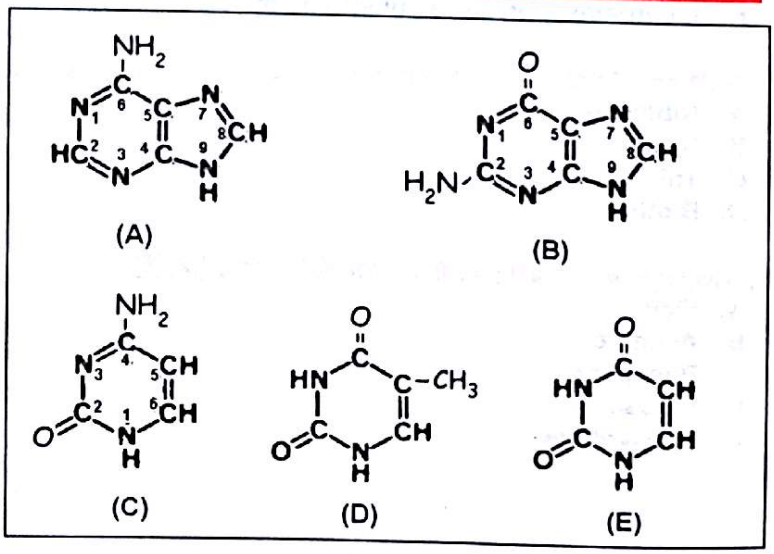
20. *Adenine is present in all of the following coenzymes EXCEPT:*
   A. NAD^+
   B. $NADP^+$
   C. FAD
   D. FMN

21. *A coenzyme NOT containing ribose is:*
   A. NAD^+
   B. $NADP^+$
   C. FAD
   D. FMN

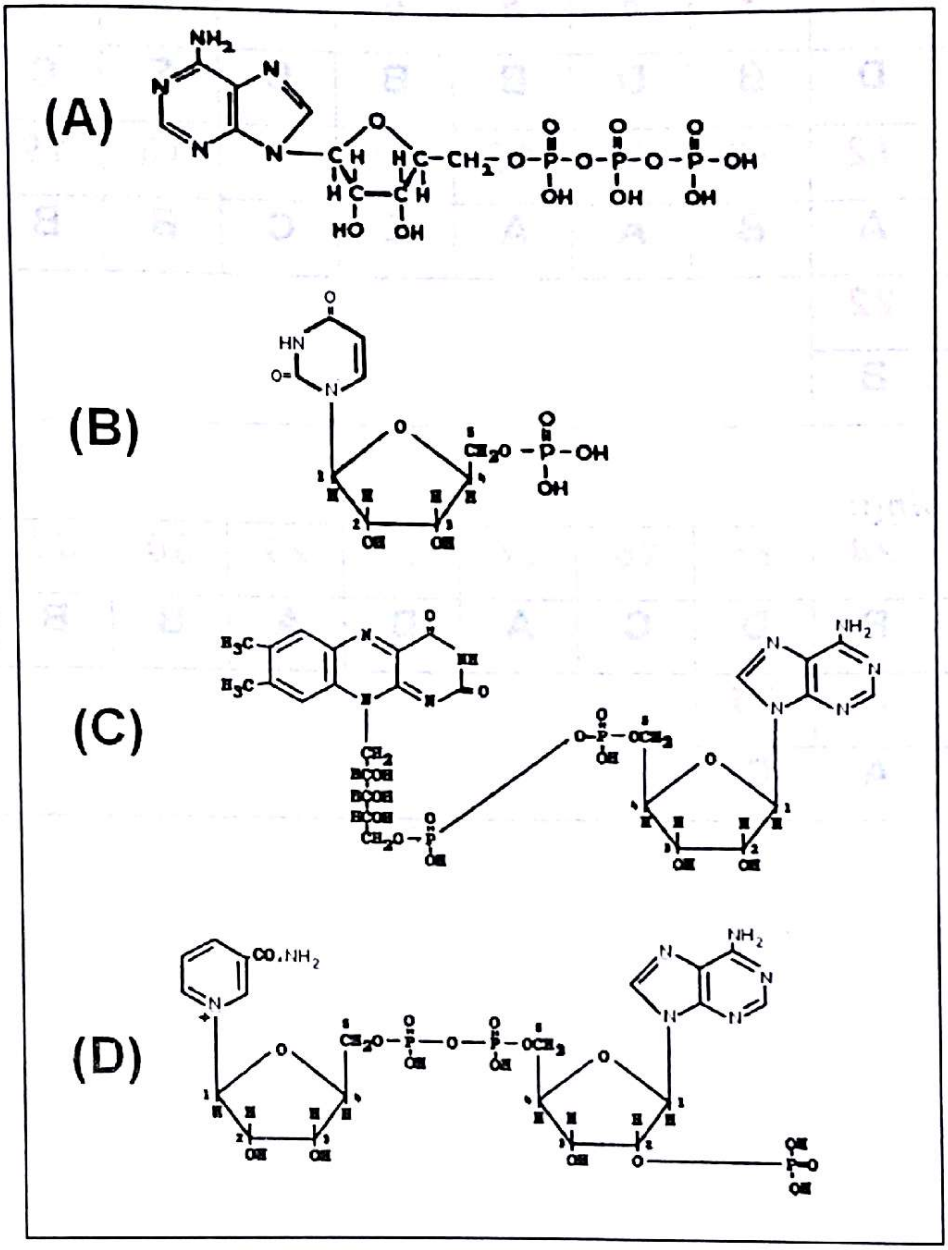
22. *Adenine is:*
   A. Pyrimidine base
   B. One of the SAM constituent
   C. 5-Methyl uracil
   D. Not present in RNA

Matching: For each set of questions, choose the ONE BEST answer from the list of lettered options below it. An answer may be used once or more times, or not at all.

23. *Uracil*
24. *Guanine*
25. *Thymine*
26. *Cytosine*
27. *Adenine*



28. *$NADP^+$*
29. *ATP*
30. *FAD*
31. *Uridine monophosphate*



32. *DNA*
33. *mRNA*
34. *tRNA*
35. *Ribosomes*

A. Carrier for amino acids from cytosol to ribosomes.
B. Its function is replication of DNA and transcription of RNA
C. Carrier for genetic information from DNA in the nucleus to ribosome in cytoplasm
D. Site of protein biosynthesis

Answer Key

MCQ:

1	2	3	4	5	6	7	8	9	10
E	D	B	D	B	B	C	E	C	D
11	12	13	14	15	16	17	18	19	20
B	A	B	A	A	E	C	B	B	D
21	22								
D	B								

Matching:

23	24	25	26	27	28	29	30	31	32
E	B	D	C	A	D	A	B	B	B
33	34	35							
C	A	D							

Chapter 7 Nucleotide Metabolism

1. *N3 and N9 of purine ring is derived from what?*

   A. *Glutamine.*

2. *Glycine donates what part of the purine ring?*

   A. *C4, C5, N7 atoms.*

3. *N1 atom of purine ring is coming from what?*

   A. *Aspartic acid.*

4. *One carbon fragments donate which carbon atoms of purine ring?*

   A. *C2 and C8 carbon atoms.*

5. *What are sources of different atoms of purine bases?*

   A. Aspartate (N1), glycine (C4, C5 and N7), glutamine (N3 and N9), CO_2 (C6), and tetrahydrofolate (or β carbon of serine) (C2 and C8).

6. *What are sources of different atoms of pyrimidine bases?*

   A. Aspartate (N1, C4, C5 and C6), and carbamoyl phosphate (C2 and N3).

7. *Which amino acid is required for both purine and pyrimidine synthesis?*

   A. *Aspartic acid and glutamine.*

8. *What is the key enzyme of de novo synthesis pathway of purines?*

   A. *The commited step in de novo synthesis is the reaction catalyzed by amido-transferase (step 1).*

9. *How is de novo synthesis of purine regulated?*

   A. *Amidotransferase enzyme is inhibited by AMP and GMP.*

10. *What are the enzymes needed for salvage pathway of purines?*

    A. *Adenine phospho -ribosyl transferase (APRTase) and hypoxanthine guaninephospho-ribosyl transferase (HGPRTase).*

11. *What is the importance of the salvage pathway?*

    A. *This is of special importance in tissues like RBCs and brain where the de novo pathway is not operating.*

12. *What is the clinical significance of the purine analogues?*

    A. *They act as cell cycle inhibitors and can be used as anti-cancer drugs.*

13. *Give a few examples of purine analogues,used as anti-cancer drugs.*

A. *(1) 6-mercapto-purine inhibits the conversion of IMP to GMP and AMP. (2) Cytosine arabinoside. (3) Folate antagonists (Methotrexate) would affect the reactions involving one carbon group transfers. (4) Azaserine is a glutamine antagonist and therefore inhibits reactions involving glutamine.*

14. *What is the end product of catabolism of purines in human beings?*

A. *Uric acid.*

15. *What is xanthine oxidase?*

A. *It is the enzyme for the reactions, hypoxanthine to xanthine and xanthine to uric acid.*

16. *What is the speciality in this reaction?*

A. *Xanthine oxidase is a metalloflavoprotein containing FAD, molybdenum and iron. As xanthine is oxidized to uric acid, hydrogen peroxide (reactive oxygen species) is produced.*

17. *What is the normal uric acid level in blood?*

A. *2 - 7 mg / dl*

18. *What is the normal urinary excretion rate of uric acid?*

A. *500 - 700 mglday.*

19. *Which property of uric acid is responsible for the manifestations of gout?*

A. *Uric acid is least soluble in water.*

20. *What is hyperuricemia?*

A. It is a condition in which serum urate is increased above normal level and exceeds its solubility limit.

21. *Increased uric acid level (hyperuricemia) is seen in which conditions?*

A. *Leukemia, gout, Lesch-Nyhan syndrome and Von Gierk's disease.*

22. *What are causes of hyperuricemia?*

A. Increase the rate of cell division and tissue turnover as in leukamia, increased activity of PRPP synthetase enzyme (as in gout), deficiency of HGPRTase enzyme (as in Lesch-Nyhan syndrome), deficiency of glucose-6-phosphatase (as in Von Gierke's disease).

23. *What are the effects of hyperuricemia?*

A. Increased insoluble urate leads to crystallization of sodium urate in soft tissues and joints, which results in formation of deposits called: tophi. The tophi cause an inflammatory reaction called gouty arthritis. The joints that firstly affected are small

joints especially those of big toe. Deposition of urate crystals in renal tubules may lead to kidney stone formation.

24. *What is the mechanism of Lesch Nyhan syndrome?*

A. Hyperuricemia resulting from deficiency of HGPRTase or APRase enzymes → Block salvage pathway →↑ PRPP → ↑ Purine synthesis (de novo synthesis) → ↑ Uric acid formation → Hyperuricemia.

25. *Hyperuricemia can result from defect of which enzymes?*

A. *Ribosyl amido transferase, PRPP synthetase, HGPRTase, APRTase, and glucose-6-phosphate.*

26. *What are the enzyme defects in Lesch-Nyhan syndrome?*

A. *HGPRTase, APRTase.*

27. *What are the salient features of Lesch-Nyhan syndrome?*

A. Mental retardation, hyperuricemia, and X-linked inheritance.

28. *What are the enzyme defects of Von Gierke's disease?*

A. *Glucose-6-phosphate*

29. *What is the mechanism of action of allopurinol?*

A. It is an analogue of hypoxanthine. It inhibits xanthine oxidase, and thereby decreasing the formation of uric acid.

30. *What type of inhibition?*

A. *Xanthine oxidase converts allopurinol to alloxanthine. It is a more effective inhibitor of xanthine oxidase. This is a good example of suicide inhibition.*

31. *Hypouricemia can result from deficiency of which enzyme?*

A. *Adenosine deaminase deficiency.*

32. *How is it manifested?*

A. *Severe immunodeficiency.*

33. *What are substrates used for pyrimidine synthesis?*

A. *Carbamoyl phosphate and aspartic acid.*

34. *What is the rate limiting step in pyrimidine synthesis?*

A. *Aspartyl trans-carbamoylase.*

35. *What is carbamoyl phosphate synthetase II and how is it different from type I enzyme?*

A. *Carbamoyl phosphate synthase-II (CPS-II) is involved in pyrimidine synthesis, but CPS-I is for urea synthesis. CPS-II is in cytosol, but CPS-I is in mitochondria. CPS-II is inhibited by CTP, whereas CPS-I is not. CPS-II present in most tissues, whereas CPS-I is present only in liver.*

36. How is pyrimidine synthesis pathway regulated in mammals?

A. CPS-II is inhibited by CTP.

37. What is the mechanism of action of 6-mercapto purine?

A. It inhibits conversion of IMP to AMP, and so acts as an antimetabolite.

38. What is the mechanism of action of 5-fluoro uracil?

A. It inhibits conversion of dUMP to dTTP, and acts as an antimetabolite.

39. Orotic aciduria is a feature of deficiency of which enzymes?

A. OMP decarboxylase, OPRTase, and ornithine transcarbamoylase.

40. What are the characteristic features of orotic aciduria?

A. Megaloblastic anemia, urinary tract obstruction, and response to oral uridine therapy.

41. Formation of dTMP (thymine nucleotide) requires what enzyme and co-enzymes?

A. Methylation of dUMP is done by thymidylate synthase. The methyl group is donated by methylene-THFA. Later, THFA is regenerated by dihydrofolate reductase, using NADPH. Methotrexate inhibits dihydrofolate reductase and thereby reduces the regeneration of THFA, and it is a powerful anticancer agent.

42. How deoxyribonucleotides are formed?

A. By the reduction at the 2' carbon of the corresponding nucleoside diphosphates (NDP to dNDP).

43. What are the enzymes and co-enzymes for this reaction?

A. Ribonucleotide reductase, NADPH, and thioredoxin.

MCQ, Matching, True and False and Completion

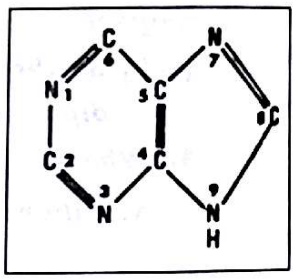
Select and encircle the most appropriate answer or completion:

1. *The absence of which enzyme involved in the "salvage pathways" of nucleotide metabolism results in a severe hereditary form of gout?*
   A. Hypoxanthine-guanine phosphoribosyl-transferase
   B. Aspartate transcarbomylase
   C. Thymidylate kinase
   D. Adenylate deaminase
   E. Xanthine oxidase

2. *The following are the sources of different atoms of purine bases EXCEPT :*
   A. Aspartate
   B. Glutamate
   C. Tetrahydrofolate
   D. Respiratory CO_2.
   E. Glycine

3. *The following are the sources of different atoms of pyrimidine bases EXCEPT:*
   A. Aspartate
   B. Glutamine
   C. Asparagine
   D. Respiratory CO_2.

4. *Carbon 4 and 5 in the purine nucleus beside are obtained from:*
   A. Glycine
   B. Alanine
   C. Acetate
   D. Aspartate
   E. Glutamate



5. *The key enzyme of de novo synthesis of purine nucleotides is:*
   A. PRPP synthase.
   B. PRPP dehydrogenase.
   C. PRPP glutamyl amido transferase.
   D. IMP dehydrogenase.

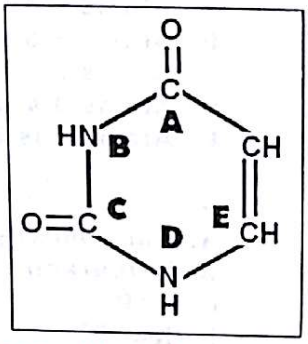
6. *PRPP is important in:*
   A. de novo synthesis of purine nucleotides.
   B. Purine salvage pathway.
   C. Synthesis of pyrimidine nucleotides.
   D. All of the above.
   E. None of the above.

7. *Lesch Nyhan syndrome is due to deficiency of:*
   A. PRPP synthetse
   B. HGPR transferase
   C. APR transferase
   D. IMP dehydrogenase

8. *Each of the following compounds is used in the biosynthesis of BOTH purine and pyrimidine nucleotides EXCEPT:*
   A. Glutamine
   B. Aspartate
   C. 5-Phosphoribosyl–1- pyrophosphate
   D. Carbamoyl phosphate
   E. Tetrahydrofolate derivatives

9. *The end product of purine metabolism that is excreted by man is:*
   A. Allantoic acid
   B. Orotic acid
   C. Urea
   D. Uric acid
   E. Xanthine

10. *Which of the following statements about the lettered ring constituents of uracil shown beside is true?*



   A. The carbon atom lettered A is derived from the carboxyl side chain of aspartic acid.
   B. The nitrogen atom lettered B is derived from the ε-amino group of lysine
   C. The carbon atom lettered C is derived from the carboxyl of methionine
   D. The nitrogen atom lettered D is derived from the amino group of glutamine
   E. The carbon atom lettered E is donated by folic acid as a free methyl group.

11. *Which of the following is true of de novo pyrimidine synthesis?*
   A. *Its synthesis starts with ribose-5-phosphate*
   B. Carbon-6 is donated by folic acid derivatives
   C. Carbamoyl phosphate donates *C2 and N3 atoms*
   D. Glycine is a carbon donor
   E. Glutamine is a nitrogen donor

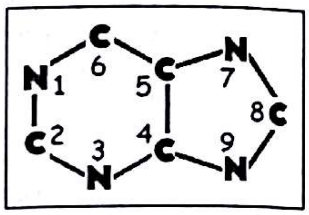
12. *Which of the following statements is true of the mitochondrial carbamoyl phosphate synthase I but not of the cytosolic enzyme (II)?*
   A. It is inhibited by uridine triphosphate (UTP)
   B. It is involved in pyrimidine biosynthesis
   C. It is present in relatively low activity
   D. It is activated by N-acetylglutamate
   E. None of the above

13. *Uracil nucleotide feedback inhibition control the activity of:*
   A. Dihydro-orotase
   B. Carbamoyl phosphate synthase II
   C. Aspartate transcarbamoylase
   D. Hydroxymethyl cytidylate synthase
   E. Orotidylic pyrophosphorylase reductase

14. *For the conversion of dUMP to TMP, which of the following is required?*
   A. Tetrahydrofolic acid
   B. ATP
   C. FMN
   D. 4'-Phosphopantothenate
   E. Pyridoxal phosphate

15. *Inosinic acid is the biological precursor of:*
   A. Orotate and uridylic acid
   B. Adenylate and guanylate
   C. Purines and pyrimidine
   D. Uracil and thymine
   E. uridylic acid and cytidylic acid

16. *In the biosynthesis of purines, tracer studies have shown that:*
   A. Atoms 7,8, and 9 are derived from urea
   B. Atoms 1,5, and 6 are derived from glycine
   C. Atoms 3, and 9 are derived from glutamine
   D. Atoms 3,4, and 5 are derived from glycine
   E. Atoms 9 is derived from aspartate



17. *The key substance in pyrimidine biosynthesis is:*
   A. Carbamoyl phosphate
   B. Thiouracil
   C. ATP
   D. $NADP^+$
   E. Ribose-5-phosphate

18. *The "commited" step in purine biosynthesis:*
   A. Ring closure of allantoin to reform uric acid
   B. The synthesis of phosphoribosylamine
   C. The synthesis of phosphoribosylpyrophosphate
   D. The formation of azaserine, which interferes with glutamine reactions
   E. Ring closure of formamidoimidazole-carboxamide ribotide to form IMP

19. *Two THFA-requiring steps of purine biosynthesis are:*
   A. Formation of phosphoribosylamine and glycinamide ribotide
   B. Formation of formylglycinamide ribotide and aminoimidazole carbxamide ribotide
   C. Formation of aminoimidazole carboxylic acid ribotide and inosinic acid
   D. Formation of formylglycinamide ribotide and formamidoimidazole carbxamide ribotide
   E. Formation of inosinic acid and adenylosuccinic acid

20. *The probable metabolic defect in gout is:*
   A. An overproduction of pyrimidines
   B. An overproduction of uric acid
   C. An underproduction of purines, leading to defective genetic material
   D. A defect in the kidney's ability to excrete uric acid
   E. Elevated calcium levels leading to the deposition of calcium uricate

21. *Orotic acid synthesis from its intermediate precursor involves:*
   A. Dihydroorotase
   B. UMP + FAD
   C. An enzyme containing FAD, FMN, and Fe
   D. Glutamate + Carbamoyl phosphate
   E. Uracil + NAD^+

22. *5-Phosphoribosyl -1- pyrophosphate (PRPP) is an intermediate in the synthesis of:*
   A. Pyrimidine nucleotides
   B. Purine nucleotides
   C. Purines
   D. NAD^+
   E. All of the above

23. *In birds, uric acid is metabolized by:*
   A. Reduction to ammonia
   B. Oxidation to allantoin
   C. Hydrolysis to allantoin
   D. Hydrolysis to ammonia
   E. Oxidation to ammonia and carbon dioxide

24. *The purine precursor that accepts CO_2 in purine synthesis is:*
   A. Glycinamide ribosyl -5- phosphate
   B. Inosinic acid Aspartate
   C. α-N-Formylglycinamide ribosyl -5- phosphate
   D. 5-Aminoimidazole ribosyl -5- phosphate

25. *The formation of uric acid from purines is catalyzed by:*
   A. Adenylate deaminase
   B. Uricase
   C. Allantoinase
   D. Urease
   E. Xanthine oxidase

In the following questions indicate with clear (T) the true statements, and with clear (F) the false statements:

The formation of urate:

26. From adenine is via the formation of xanthine
27. From guanine is via the formation of hypoxanthine
28. From purines depends on xanthine oxidase activity
29. From xanthine is via hypoxanthine
30. Is the last stage of purine breakdown in most mammals

In the synthesis of purines:

31. The rate limiting step is the conversion of phosphoribosyl pyrophosphate to phosphoribosylamine
32. Amino groups are incorporated from glutamine and glycine
33. The final stage is the addition of ribose phosphate
34. Nucleic acids are formed in the intermediate stages
35. The rate-limiting step is subject to feedback inhibition from increased levels of purine nucleotides

Characterstic features of Lesch-Nyhan syndrome include:

36. Failure of conversion of xanthine to urate
37. Mental retardation
38. Hypourecemia
39. Increased hypoxanthine guanine phosphribosyl transferase activity
40. Causes gouty arthiritis

Recognized causes of hyperurecemia include:

41. Leukemia
42. Lead poisoning
43. Over activity of glucose -6-phosphatase
44. Over activity of hypoxanthine guanine phosphribosyl transferase
45. Over activity of PRPP synthase

The nitrogens of the purine ring are derived from:

46. Aspartic acid
47. Glycine
48. Glutamine
49. Serine
50. Histidine

Uric acid is a breakdown product of:

51. AMP
52. GMP
53. IMP
54. CMP
55. UMP

***Matching:** For each set of questions, choose the **ONE BEST** answer from the list of lettered options below it. An answer may be used once or more times, or not at all.*

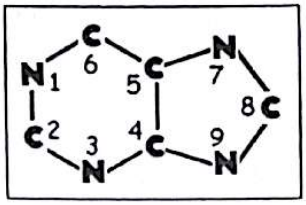
56. *Source of N_1 of purine ring.*
57. *Source of C_4, C_5 and N_7. of purine ring.*
58. *Source of N_3 and N_9 of purine ring.*
59. *Source of C_6 of purine ring.*
60. *Source of C_2 and C_8 of purine ring.*

A. Tetrahydrofolate.
B. Aspartate
C. CO_2
D. Glutamine
E. Glycine

61. *Thymine*
62. *Uracil*
63. *Hypoxanthine*
64. *Adenine*
65. *Uric acid*

A. 6-Aminopurine
B. 6-Oxypurine
C. 2,6,8-Trioxypurine
D. 2,4-Dioxypyrimidine
E. 5–Methyl-2,4-dioxypyrimidine

66. N_1.
67. C_4, C_5 and N_7
68. N_3 and N_9
69. C_6
70. C_2 and C_8



A. Tetrahydrofolate
B. Aspartate
C. CO_2
D. Glutamine
E. Glycine

71. *AMP*
72. *Adenosine*
73. *Adenine*
74. *Uracil*
75. *DNA*
76. *RNA*

A. Purine
B. Pyrimidine
C. Nucleoside
D. Nucleotide
E. Nucleic acid

Answer Key

MCQ:

1	2	3	4	5	6	7	8	9	10
A	B	C	A	A	A	B	D	D	E
11	12	13	14	15	16	17	18	19	20
C	D	B	A	B	C	A	B	D	B
21	22	23	24	25					
C	E	B	D	E					

True and false:

26	27	28	29	30	31	32	33	34	35
T	F	T	F	F	T	T	F	F	T
36	37	38	39	40	41	42	43	44	45
F	T	F	F	T	T	T	F	F	T
46	47	48	49	50	51	52	53	54	55
T	T	T	F	F	T	T	T	F	F

Matching:

56	57	58	59	60	61	62	63	64	65
B	E	D	C	A	E	D	B	A	C
66	67	68	69	70	71	72	73	74	75
B	E	D	C	A	D	C	A	B	E
76									
E									

Chapter 8 Nucleic acid Metabolism And Molecular Biology

1. *What is chromosome?*
   A. These are nucleoproteins, formed mainly of DNA and basic proteins, and they bear genes.
2. *How many chromosomes in man?*
   A. 46
3. *What is the functions of chromosomes?*
   A. They act as functional units of hereditary. They are capable of reproducing themselves exactly through replication.
4. *What is gene?*
   A. It is a part of chromosome, which occupy a specific position (locus) on it. It is responsible for determination of certain character.
5. *What is genome?*
   A. It is the total chromosomal (DNA) content of a cell.
6. *What is chromatin?*
   A. It is the chromosomal material that formed of a condensed DNA-protein complex.
7. *What is composition of chromatin?*
   A. Double stranded DNA complex, histones, protamines and small quantity of RNA.
8. *What are histones?*
   A. Histones are small basic proteins rich in histidine, lysine and arginine.
9. *How many calsses of hostones?*
   A. There are 5 major classes of histones, H1 (which binds to the DNA chain between the nucleosome beads) and H2A, H2B, H3 & H4 (which form nucleosome).
10. *What are the modifications seen in histones?*
    A. Acetylation, methylation, and phosphorylation.

11. *What are the important characteristics of Watson-Crick model of DNA?*

A. Right-handed double helix, each turn of helix has 10 base pairs. The 2 strands are hydrogen bonded through purines and pyrimidines. Two strands of DNA running in opposite directions (anti parallel).

12. *Which enzymes protect cellular ageing?*

A. *Telomerases.*

13. *What is base pairing rule?*

A. In double stranded DNA, adenine in one strand is paired with thymine in the other strand, and guanine in one strand is paired with cytosine in the other strand. This means that purines are paired with pyrimidines (A + G = T + C).

14. *What type of bonds between bases?*

A. hydrogen bonding.

15. *Which contains stronger hydrogen bonding, A+T or G + C?*

A. GC is stronger because it contains 3 hydrogen bonds while AT contains only 2 hydrogen bonds.

16. *What is nucleosome?*

A. DNA wrapped around histones.

17. *What is meant by DNA replication?*

A. During cell division, each daughter cell gets an exact copy of the DNA of the parent cell. (parent DNA → 2 Similar copies of daughter DNA).

18. *What is semi-conservative replication?*

A. The daughter DNA consists of one strand from parent cell, and one new complementary strand.

19. *What are the proteins required for separation of DNA during replication?*

A. DNA helicase, helix destabilizing proteins (HD), and topoisomerases.

20. *What are the enzymes required for DNA replication?*

A. DNA polymerases, topoisomerase, and DNA ligase.

21. *How many DNA polymerases are there in mammalian cells?*

A. Five, Alpha (α), beta (β), gamma (γ), delta (δ), and epsilon (ε).

22. *How many DNA polymerases are there in prokaryotic cells?*

A. Three, I, II, and III.

23. *What are steps of DNA replication?*

A. Strand separation (unwinding of parental DNA), formation of RNA primer, synthesis of new DNA strands, and excision of RNA primers and their replacement with DNA.

24. *What is a replication bubble?*

A. Helicases move on both directions, separating the strands in advance of the replication. This forms a replication bubble.

25. *Which direction new strand of DNA is taking place?*

A. Polymerization of the new strand of DNA is taking place from 5' to 3' direction. This means that the template is read in the 3' to 5' direction.

26. *How replication starts?*

A. By separation of the double stranded DNA using DNA helicase, helix destabilizing proteins (HD), and topoisomerases.

27. *What is RNA primer?*

A. RNA primer is about 100-200 nucleotides long, and is synthesized by the RNA primase. It is common in lagging strand.

28. *What is meant by semi-discontinous nature of replication?*

A. DNA synthesis is always in the 5' to 3' direction in both strands. Replication fork advances towards one side. Therefore, in one strand, the replication is taking place continuously, but in the other strand, replication is in small pieces. These pieces are called Okazaki fragments.

29. *What is leading strand?*

A. It is the strand, which is continuously synthesized, toward the moving fork.

30. *What is lagging strand?*

A. It is the strand, which is discontinuously synthesized away from moving fork, by forming small fragments called Okazaki fragments.

31. *What are okazaki fragments?*

A. The lagging strand is synthesized discontinuously by forming small fragments called Okazaki fragments. After RNA primers are removed the Okazaki fragments are joined by ligases and the lagging strand becomes a single continuous strand.

32. *Xeroderma pigmentousum is due to deficiency of what process?*

A. *Defect in DNA excision repair mechanism* (thymine-thymine dimer)

33. *Xeroderma pigmentousum is due to deficiency of which enzyme?*

A. *UV-specific endonuclease.*

34. *In prokaryotes, DNA replication is inhibited by what drugs?*

A. By certain antibiotics ciprofloxacine, nalidix acid, and novobiocin.

35. *DNA replication in eukaryotes is inhibited by what drugs?*

A. By certain nucleotide analogs as arabinofuranosyl cytosine, 5-fluoro uracil and 6-mercaptopurine.

36. *Defect in DNA repair mechanisms produce what clinincal conditions?*

A. *Xeroderma pigmentousum, ataxia-telangectasia, Fanconi's anemia, and Bloom's syndrome.*

37. *What are types of DNA repair?*

A. Excision repair, mismatch repair, and double stranded DNA repair.

38. *What are types of DNA excision repair?*

A. (Thymine-thymine dimer) (Pyrimidine-pyrimidine dimer) and Cytosine deamination to uracil (C → U + NH2).

39. *What is the mechanism of repair of* thymine-thymine dimmer ?

A. single cut by UV specific endonuclease. Gap filled by DNA polymerase I. Removal of thymine-thymine dimmer region by exonuclease. Remaining nick is sealed by ligase.

40. *What does cytosine deamination mean?*

A. It means removal of amino group from DNA cytosine to give uracil.

41. *What is the mechanism of repair of cytosine deamination?*

A. Removal of abnormal base (U) by uracil DNA glycosylase. Removal of the remaining phosphodiester backbone by endonuclease. Gap is filled by DNA polymerase I. Remaining nick is sealed by ligase.

42. *What does mismatch mean?*

A. Single base error (G is replaced by U) or (G is replaced by C) or presence of 2-5 Unpaired bases.

43. *What is the mechanism of mismatch repair?*

A. Endonuclease recognizes error at the sequence (GATC), making a Single cut. Error is removed by exonuclease. Defect is repaired by polymerase I. Remaining nick is sealed by ligase.

44. *What does double stranded DNA error mean?*

A. Means complete cut of the double stranded DNA.

45. *What is the mechanism of repair of double stranded DNA break?*

A. (1) Binding of Ku and DNA-PK proteins to both ends of cut. They approximate both ends and unwind the free ends by helicase

activity of Ku protein. (2) Alignment and base pairing of free ends. (3) Excision of extra nucleotide tails by exonuclease. (4) Gaps are filled and sealed by ligase.

46. *In which phase of the cell cycle, DNA synthesis is maximum?*

A. *S phase.*

47. *What is transcription?*

A. *The process of making a complementary mRNA copy of DNA.*

48. *What are names of DNA strands?*

A. Template and coding strands.

49. *The mRNA is a complementary copy of which strand of DNA?*

A. *Template strand.*

50. *What is coding strand?*

A. *The opposite strand of template strand. Coding strand has the same sequence as of the mRNA.*

51. *What is the enzyme necessary for the transcription in prokaryotics?*

A. *DNA dependent RNA polymerase or RNAP.*

52. *What are the different types of eukaryotic RNA polymerases?*

A. RNAP type I, II, III. Type I is responsible for synthesis of large rRNA, Type II is the enzyme synthesizing mRNAs, and type III is responsible for production of tRNA and the small 5S ribosomal RNA..

53. *What is the direction of transcription?*

A. *5' to 3' direction.*

54. *What is pribnow box (TAtA box)?*

A. It is certain sequence of prokaryotic DNA bases located at the beginning of stretch. It is about 10 bp upstream of starting of mRNA synthesis.

55. *What is the importance of pribnow box?*

A. It can be recognized by RNA polymerase and important for initiation of transcription.

56. *What is the corresponding signal in eukaryotes?*

A. Hogness Box. It is located at 25 to 30 positions.

57. *What are enhancers?*

A. These are specific segments present in DNA, which control and increase the rate of transcription in eukaryotes. When a specific protein (e.g. hormone) is attached to enhancer, the rate of transcription will increase.

58. *Where does enhancer lie?*

A. Its position is several thousands base pairs apart from the transcription unit. It may be upstream (before promotor) or downstream (after termination region).

59. *What are steps of transcription?*

A. Initiation, elongation, and termination.

60. *What is the function of sigma (σ) subunit?*

A. It enables polymerase to recognize promotor region on DNA.

61. *How termination of transcription is effective?*

A. Termination results from either (1) binding of rho factor to polymerase enzyme and releasing mRNA (2) slowing down of RNA polymerase at the termination site by the presence of palindromes.

62. *What is palindrome?*

A. It is a region of a double stranded DNA in which each of the two strands has the same sequence when read in the same direction e.g. in the 5` to 3` direction.

63. *How palindromes affect termination of transcription?*

A. The RNA transcript of the DNA palindrome can form a stable hairpin structure, which is a self-complementary structure. This hairpin structure causes slowing down of RNA polymerase at the termination site.

64. *What are post-transcriptional modifications?*

A. These are changes that occurs to all types of RNA after transcription:

65. *What are post-transcriptional modifications for mRNA?*

A. Splicing (Removal of introns), addition of a cap at 5' end, and adding poly A tail at 3' end and methylation.

66. *What is intron?*

A. *Part of mRNA that is removed by splicing.*

67. *May introns be translated into amino acids?*

A. Heterogeneous nuclear RNA (HnRNA) is formed of many pieces, some of them (exons) will be translated into amino acids. Others (introns) will not be translated into amino acids and must be removed before translation takes place. This can be removed by spliceosomes.

68. *What are structure of spliceosome?*

A. Spliceosomes consist of the primary hnRNA, 5 small nuclear RNAs (U1, U2, U5 and U4/U6) and more than 50 proteins.

69. What are functiosn of spliceosome?

A. Removal of introns from the hnRNA, and splicing (ligation) of both ends of exons to form mature mRNA. The role of small nuclear RNAs (snRNA) is to bind each end of the intron by forming base pair with each other. Spliceosomes facilitate also the transport of mature mRNA from the nucleus to the cytosol.

70. What is 5' end capping?

A. It is attachment of 7-methyl guanosine triphosphate at 5' end of mRNA. This reaction needs guanisyl transferase enzyme.

71. What is the importance of 5' end capping?

A. Facilitates the initiation of translation and protect the 5' end of mRNA from attack by 5' to 3' exonucleases.

72. What is 3' end tailing?

A. Most mRNAs require almost 40 to 200 adenine nucleotides added at the 3' terminus to form a poly adenine (poly A) tail. This reaction needs an enzyme called poly A polymerase enzyme.

73. What is the importance of 3' end tailing?

A. To protect the 3' end of mRNA from attack by 3' to 5' exonucleases.

74. What is the functions of tRNA?

A. They serve as adaptor molecules for the translation of mRNA into protein sequence.

75. What are post-transcriptional modifications for tRNA?

A. (1) Attachment of C.C.A. terminus at the 3' end, (2) methylation of some bases, (3) reduction in size by specific class of ribonucleases, (4) removal of a single intron present near the anticodon.

76. What are post-transcriptional modifications for rRNA?

A. In mammalian cells, rRNA is transcribed as a single large precursor molecule called 45 S. In the nucleus, 45 S is methylated and cleaved by specific end nucleases and exonucleases to give 4 kinds of rRNA: 5 S rRNA, 5.8 S rRNA, 18 S rRNA and 28 S rRNA.

77. What are the non-coding sequences?

A. Poly-A tail, introns and leader sequence,.

78. What is the cause for systemic lupus erythematosis?

A. Production of auto antibodies against small nuclear ribonucleoprotein particles cause systemic lupus erythematosis (SLE), a fatal autoimmune disease.

79. Give the names of inhibitors of RNA synthesis.

A. Rifamycin and actinomycin D.

80. What is the mechanism of action of Rifampicin?

A. Rifamycin is an antibiotic widely used in the treatment of tuberculosis and leprosy. It binds to the β subunit of RNA polymerase, and inactivates it.

81. What is the mechanism of action of actinomycin?

A. Actinomycin D is an antibiotic, which binds to the DNA strands, thus blocking transcription. They are used as anticancer drugs.

82. What is reverse transcriptase?

A. In some viruses (retroviruses), RNA is the genetic material (not DNA). Reverse transcriptase will make a new DNA strand based on the RNA template. Thus, genetic information is transferred from RNA to DNA.

83. What is the mechanism of replication:

A. Viral reverse transcriptase can synthesize a single stranded and then double stranded DNA molecule from the viral single stranded RNA template.

84. What is the other name of reverse transcriptase?

A. The RNA dependent, DNA polymerase

85. Give an example of retrovirus.

A. The human immunodeficiency virus (HIV) causing AIDS is a retrovirus. Hepatitis A virus is also a retrovirus.

86. What is the importance of of reverse transcriptase in diagnosis of diseases?

A. Reverse transcriptase enzymes are important in recombinant DNA technology.

87. What are the structural features of tRNA molecule?

A. It is one strand having 3 loops. It contains methylated bases. Amino acid binding is at 3' end. The opposite part has anticodon arm.

88. During replication, DNA is synthesized in which direction?

A. From 5' to 3' direction.

89. During transcription, mRNA is synthesized in which direction?

A. From 5' to 3' direction.

90. During translation, protein is synthesized in which direction?

A. From amino terminal end to carboxy terminal end.

91. *During protein synthesis, what specify amino acid sequence?*

A. The codons present in messenger RNA.

92. *What is codon?*

A. Consecutive three nucleotide base pairs in messenger RNA, which determines the type and position of the amino acid during protein synthesis.

93. *How many different codons may be arised from 4 nucleotide bases: adenine, guanine, cytosine and uracil?*

A. 64

94. *What is genetic code?*

A. It is the sequence of nucleotides along the DNA that can be translated into the amino acids of proteins. (= a collection of codons).

95. *What are characters of the genetic code?*

A. Specificity (unambiguous), degeneracy, non-overlapping and universality.

96. *What is meant by Specificity (unambiguous) of genetic code?*

A. Specific codon always codes for only a single amino acid.

97. *What is meant by Degeneracy of genetic code?*

A. Multiple codons code for the same amino acid.

98. *What is meant by Non-overlapping of genetic code?*

A. Codons do not overlap each other.

99. *What is meant by Universality of genetic code?*

A. The genetic code is the same for all species of plants and animals.

100. *What is meant by the term wobbling?*

A. Anticodons pair with codons that differ at the third base.

101. *What is the initiating codon for protein synthesis?*

A. AUG.

102. *What is Shine-Dalgarno sequence?*

A. Marker of start signal for translation in bacterial mRNA.

103. *Where is protein biosynthesis taking place?*

A. Ribosomal assembly attached either to endoplasmic reticulum, or in cytosol.

104. *How many high energy bonds are required for the synthesis of one Peptide bond?*

A. Four high energy bonds.

105. *What are steps of translation of genetic code?*

A. Activation of amino acids, initiation, elongation and termination.

106. *What is meant by post-translational modifications?*

A. These are modification (changes), which occurs to protein after translation.

107. *Give examples for post-translational modifications.*

A. Hydroxylation of proline in collagen, glycosylation, phosphorylation, conversion of zymogens into enzymes and δ-carboxylation of prothrombin.

108. *Give examples of diseases produced by defect in post-translational modifications.*

A. Scurvy, Lathyrism, and Ehlers-Danlos syndrome.

109. *Give examples of inhibitors of translation in eukaryotic cells.*

A. Streptomycin, tetracyclines, chloramphinicol, puromycin, and diphtheria toxins.

110. *What is the mechanism of action of streptomycin?*

A. It binds to the ribosome, distorting its structure. It causes dissociation of mRNA from the ribosomes.

111. *What is the mechanism of action of tetracyclines?*

A. Inhibition of tRNA anticodons to bind with their corresponding codons in mRNA.

112. *What is the mechanism of action of puromycinn?*

A. Its structure resembles the structure of aminoacyl-tRNA. It becomes incorporated into the growing peptide chain, thus causing inhibition of further elongation.

113. *What is the mechanism of action of chloramphenicol?*

A. Inhibition of peptidyl transferase enzyme in bacteria.

114. *What is the mechanism of action of diphtheria toxins?*

A. Inactivate the eukaryotic elongation factor-2 (eEF-2), thus preventing translation.

115. *Leber's hereditary optic neuropathy is due to what?*

A. *Due to mutation in mitochondrial DNA.*

116. *What is a mutation?*

A. An alteration in the genetic nucleotide sequence.

117. *Give examples for mutagens.*

A. Some anti-malignant drugs, nitrous acid, X-rays, δ-rays, and methyl cholanthrene.

118. *What are types of mutation?*

A. Point mutations and frame shift mutations.

119. *What are point mutations?*

A. These are a single base substitution of one base for another.

120. *What are types of point mutation?*

A. Transition and transversion mutations.

121. *What is transition mutation?*

A. One pyrimidine is substituted to another pyrimidine or one purine is substituted to another purine.

122. *What is transversion mutation?*

A. One purine is substituted to either of the 2 pyrimidines or one pyrimidine is substituted to either of the 2 purines.

123. *What are effects of point mutation?*

A. Silent, missense and nonsense mutations.

124. *What is silent mutation?*

A. The codon containing the changed base still codes for the same amino acids.

125. *What is nonsense mutation?*

A. Codon containing the changed base may become the termination codon.

126. *What is missense mutation?*

A. The codon containing the changed base codes for different amino acids.

127. *What is the effect of missense mutation on the functions of proteins?*

A. It depends upon the location of the substituted amino acid in that protein. It may produce acceptable functioning protein, partially acceptable less functioning protein and unacceptable non-functioning protein.

128. *Give an example of point mutation.*

A. *HbS or sickle-cell hemoglobin is produced by a mutation of the beta chain in which the 6^{th} position is changed to valine, instead of the normal glutamate.*

129. *What type of mutation is it?*

A. Transversion, missense, and partially acceptable point mutation as the normal codon GAG is changed to GUG.

130. *What is hemoglobin C?*

A. HbC is produced by a mutation of the beta chain in which the 6th position is changed to lysine, instead of the normal glutamate.

131. *What are frame shift mutation?*

A. Mutation due to either deletion or addition of one or more nucleotide(s) in DNA that generates altered mRNA.

132. *What are effects of frame shift mutation?*

A. (1) Garbled translation of the mRNA distal to a single nucleotide deletion, (2) premature termination of polypeptide due to appearance of nonsense codon near the –COOH terminus.

133. *What is recombinant DNA molecule?*

A. It is a new DNA molecule, which contains both human and bacterial DNA sequences i.e. contains genetic information from human and bacterial DNA.

134. *What are required for preparing a recombinant DNA molecule?*

A. Donor, plasmid vector, restriction endonuclease, and DNA ligase.

135. *What are restriction endonucleases?*

A. They are referred to as "molecular scissors". These enzymes recognize specific sequence with palindrome arrangement in the double stranded DNA, and then cleave at those sites. They are useful in recombinant DNA technology.

136. *What is the technique used for gene amplification?*

A. Cloning (in vivo) and polymerase chain reaction (in vitro).

137. *What is meant by the term cloning?*

A. It is the production of a large number of identical molecules, bacteria or cells arising from a common ancestor.

138. *What is meant by the term somatic cloning?*

A. When a cell from an animal is grown to an exact duplicate of that animal, it is known as "cloning of an animal" or "somatic cloning"

139. *What are the applications of cloning of animals?*

A. Animals with genetically desirable traits could be bred more efficiently, e.g. cows yielding more milk. Cows or goats may be genetically engineered to produce milk containing any human protein.

140. *What is cloning vector?*

A. This is the carrier part of the recombinant DNA molecule.

141. *What are features of cloning vector?*

A. It must have two important properties for its functions, the ability to enter the cell and the ability to replicate.

142. *What are types of cloning vectors?*

A. Bacterial plasmid, phage or cosmid.

143. *What is plasmids?*

A. These are extra-chromosomal small circular, duplex DNA molecules, present in bacteria.

144. *What is natural function of plasmids?*

A. They give antibiotic resistance to the host cells.

145. *Why plasmids are used as cloning vectors?*

A. (1) They replicate independently from the bacterial DNA and exist as single or multiple copies within the bacterium. (2) The complete DNA sequence of many plasmids is known, hence the exact location of restriction enzyme cleavage sites for inserting the donor DNA is available. (3) Plasmids are easily separated from the bacterial chromosomes because they are smaller than them. (4) The desired DNA segment is removed by cutting the plasmid with restriction enzyme. The donor DNA is then inserted into this site.

146. *What is phage?*

A. They are type of viruses (*retrovirus, adenovirus*) that live in bacteria. They usually have linear DNA molecules into which donor DNA can be inserted at several restriction enzyme sites.

147. *What is cosmid?*

A. These are plasmids that act as vectors for large fragments of DNA than do both phages and other plasmids.

148. *What is cloning of recombinant DNA?*

A. It is the putting of plasmids containing the donor DNA into the host cells (bacteria, animal or plant cells), which then continue to replicate. In this way, the recombinant DNA (chimeric DNA) is amplified.

149. *What is PCR?*

A. It is a technique used to amplify a small piece of viral DNA in clinical samples up to a million folds. This allows detection of small quantities of infectious agent as viruses in a single sample.

150. *What is reverse PCR?*

A. This allows cDNA synthesis from mRNA followed by PCR amplification.

151. *What is the use of PCR?*

A. Diagnosis of bacterial and viral diseases, medico-legal cases, diagnosis of genetic disorders, especially prenatal diagnosis, tissue typing for transplants, study of evolution by using DNA from archeological sample and detection allelic polymorphism.

152. *What is genomic library?*

A. A collection of cloned fragments that represents the entire genome. It includes both introns and exons.

153. *What is complementary DNA library?*

A. It is a collection of cloned fragments that represents only the exons (or represents the population of mRNA in a cell).

154. *What is probe?*

A. Probes are pieces of DNA or RNA labeled with a radioactive phosphorous (^{32} P). They can recognize the specific gene or cDNA molecule which is complementary to its base sequence. Probes also can be used to define and measure quantities of DNA or RNA that separated by electrophoresis.

155. *What is gene mapping?*

A. It means localization of specific genes in distinct chromosomes i.e. construction of map of the human genome.

156. *What is Northern blotting?*

A. Technique used to demonstrate specific RNA.

157. *Give example for diseases diagnosed by northern blotting?*

A. HIV (AIDS) virus.

158. *What is Southern blotting?*

A. Technique used to demonstrate specific DNA.

159. *What is the technique of Southern blotting?*

A. Cleavage of DNA by restriction endonucleases, electrophoresis in agarose gel, blotting over a nitrocellulose membrane, hybridization with radioactive probe and autoradiography.

160. *How is DNA fragments separated?*

A. By agarose gel electrophoresis.

161. *What is the use of southern blotting?*

A. To identify abnormal genes, to demonstrate virus integration, prenatal diagnosis.

162. *Give some examples of genetic diseases that could be identified by Southern blotting.*

A. Sickle cell anemia and Duchenne muscular dystrophy.

163. *What is Western blotting?*

A. It is a technique by which specific proteins (not nucleic acids) can be separated, analyzed and identified.

164. *RFLP (restriction fragment length polymorphism) is used for what?*

A. Locating mutations in DNA.

165. *What is the application of DNA fingerprinting?*

A. It has medico-legal application.

166. *Give some diseases in which gene therapy is used successfully?*

A. Severe combined immunodeficiency, duchenne muscular dystrophy, cystic fibrosis, familial hypercholesterolemia, and hemophilia.

167. *What is transgenesis?*

A. It is a form of germ cell gene therapy. A recombinant DNA segment, containing the desired gene from another species is introduced into the fertilized ova. The embryos are allowed to develop in the uterus of another animal.

168. *What is the biochemical importance of recombinant DNA technology?*

A. Gene mapping, production of proteins (for treatment, research and diagnosis), gene therapy, molecular analysis of diseases, diagnosis of fetal genetic disorders and detection of polymorphism.

169. *What is gene mapping?*

A. It means localization of specific genes in distinct chromosomes i.e. construction of map of the human genome.

170. *What is the biochemical importance of gene mapping?*

A. Somatic cell chromosomes are hybridized with specific radioactive probe. By this way, the exact area of hybridization is localized and we can know the exact place of gene on the chromosome. By using other radioactive probes, one after another, other gene localization can be identified. This leads to construction of a gene map. Gene mapping gives useful information about human diseases.

MCQ, Matching, True and False and Completion

Select and encircle the most appropriate answer or completion:

1. *In DNA adenine is linked to thymine via:*
   - A. 1 Hydrogen bond
   - B. 2 Hydrogen bonds
   - C. 3 Hydrogen bonds
   - D. 4 hydrogen bonds

2. *Each tRNA molecule contains anticodon which consists of:*
   - A. Three base nucleosides
   - B. Three base nucleotides
   - C. Four base nucleosides
   - D. Four base nucleotides

3. *The processing of the primary tRNA modification involves all of the following EXCEPT:*
   - A. Addition of characterstic poly A terminus at 5´ end of the molecule.
   - B. Attachment of the characterstic CCA terminus at 3´ end of the molecule.
   - C. Methylation of some standard bases.
   - D. Reduction in size.
   - E. Removal of a single intron that lies nears the anticodon region.

4. *Which of the following amino acids is synthesized only posttransaltionally, after incorporation of a precursor into a polypeptide?*
   - A. Hydroxyproline
   - B. proline
   - C. Glutamate
   - D. Serine
   - E. Glycine

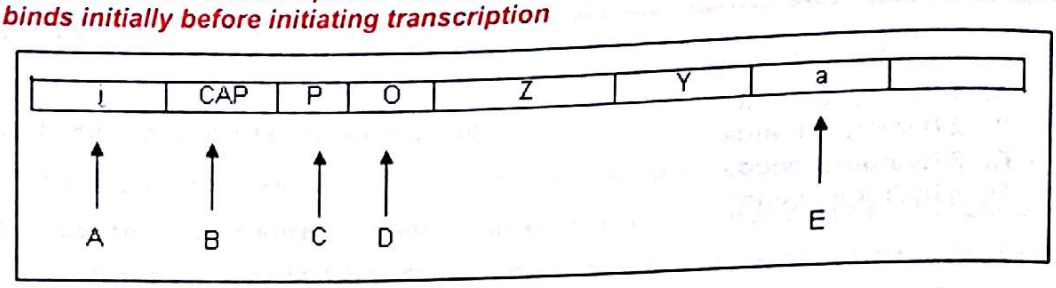
5. *Adenine is:*
   - A. Pyrimidine base
   - B. A constituent of SAM
   - C. 5-Methyl uracil
   - D. Not present in RNA

6. *Catabolism of purine bases gives:*
   - A. Hippuric acid
   - B. Cholic acid
   - C. Uric acid
   - D. Urea

7. *In DNA thymin is linked with:*
   - A. Deoxyribose
   - B. Ribose
   - C. Ribulose
   - D. Ribitol
   - E. Arabinose

8. *Medical uses of PCR include:*
   A. Diagnosis of viral hepatitis
   B. Diagnosis of cancer
   C. Diagnosis of some bacterial infections
   D. All of the above

9. *The location on the lac operon shown below where RNA polymerase (sigma factor) binds initially before initiating transcription*



   A. A
   B. B
   C. C
   D. D
   E. E

10. *In the above figure, where cAMP binds?*
   A. A
   B. B
   C. C
   D. D
   E. E

11. *In the above figure, which segment is repressor gene?*
   A. A
   B. B
   C. C
   D. D
   E. E

12. *The initiation codon for translation is;*
   A. UAA
   B. AUG
   C. AGU
   D. UAC
   E. GUA

13. *One of the termination codon is:*
   A. UAA
   B. AUG
   C. AGU
   D. UAC
   E. AUU

14. *Ribosome 80 S is formed of:*
   A. 40 S + 40 S
   B. 70 S + 10 S
   C. 60 S + 20 S
   D. 40 S + 60 S

15. *The acceptor arm of tRNA is:*

A. CCA
B. AUG
C. UAC
D. AGU
E. AAC

16. *Which of the following factors leads to an increased melting temperature for double stranded DNA?*

A. High content of adenine(A) + guanine (G).
B. High content of cytosine(C) + thymine (T).
C. High content of cytosine(C) + guanine (G).
D. High content of adenine(A) + thymine (T).
E. None of the above.

17. *Replication means:*

A. DNA → mRNA
B. DNA → DNA
C. mRNA → protein
D. non of the above

18. *One cause of mutations:*

A. Use of antimalignant drugs
B. Use of some anticoagulant
C. Use of some antibodies
D. Use of some antibiotics

19. *Xeroderma pigmentosum is due to deletion of the genes that encode:*

A. N-Glycosylase
B. UV-specific endonuclease
C. DNA protein kinase
D. DNA polymerase II

20. *All the following concerning Lac operon are false EXCEPT:*

A. It is composed of structural gene(s), control genes and regulatory gene.
B. Regulatory gene is responsible for synthesis of inducer.
C. Expression of Lac operon occurs in the presence of both glucose and lactose.
D. Repressor facilitates binding of RNA polymerase with promoter area.
E. Structural genes are translated into two proteins.

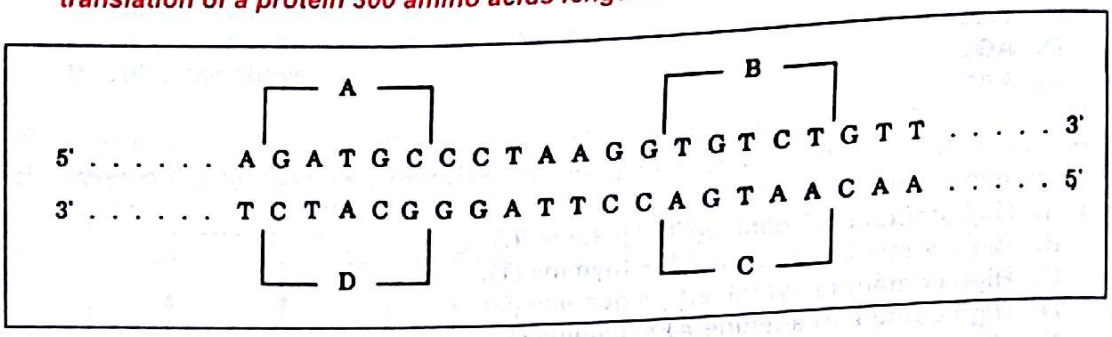
21. *The only compound that receives a methyl group from tetrahydrofolate and not from S-adenosyl methionine is:*

A. Creatine phosphate.
B. Epinephrine
C. Melatonine
D. Phosphatidyl choline
E. Thymine

22. *Which RNA contains poly adenine nucleotides at the 3' end?*

A. 5 S RNA.
B. 28 S RNA.
C. tRNA.
D. mRNA.
E. snRNA

23. *Which region (A to D) of the DNA strands shown could serve as a template for transcription of the region of an mRNA that contains the initial codon for translation of a protein 300 amino acids length?*

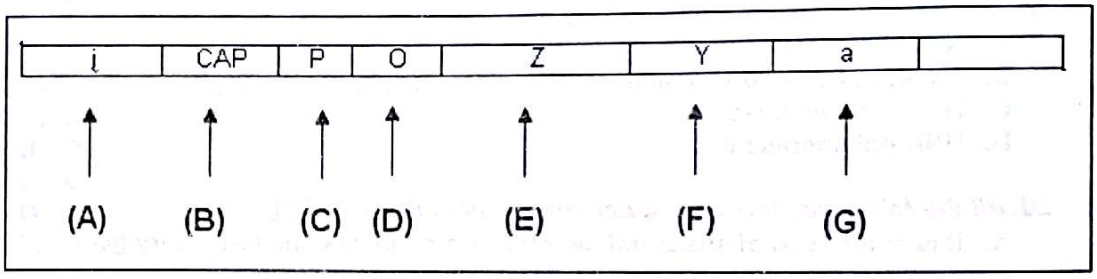


A. A
B. B
C. C
D. D

24. *Polymerase chain reaction (PCR) is a technique for:*

A. Sequencing DNA
B. Amplifying DNA
C. Sequencing amino acids
D. Detection of gene translocation
E. Detection of gene mutation

25. *In the location on the lac operon shown below where repressor protein binds.*



A. A
B. B
C. C
D. D
E. E

26. *In the above figure, which segments transcribe polycistronic mRNA?*

A. *A – B - C*
B. B – C – D
C. E – F - G
D. C – D - E
E. D – E – F

27. *A codon consists of:*

A. One molecule of aminoacyl-tRNA.
B. Two complementary base pair.
C. Three consecutive nucleotides.
D. Four individual nucleotides.

28. *The anticodon sequence is seen in:*
   A. mRNA.
   B. rRNA.
   C. Complementary DNA.
   D. tRNA.

29. *The genetic code is:*
   A. Nondegenerate
   B. Species specific
   C. A triplet code
   D. Punctuated
   E. Translated by RNA polymerase

30. *The nucleosome core contains:*
   A. One copy each of histone H2A, H2B, H3 and H4.
   B. Two copies each of histones H2A, H2B, H3 and H4.
   C. DNA covalently linked to histones.
   D. Histone H1.
   E. RNA polymerase.

31. *Mammalian RNA polymerase I synthesizes:*
   A. 5 S RNA
   B. tRNA
   C. mRNA
   D. Both tRNA and 5 sRNA
   E. Large rRNAs

32. *In double stranded DNA molecule:*
   A. Adenine equals thymine.
   B. Adenine equals uracil.
   C. Guanine equals adenine.
   D. Cytosine equals thymine.
   E. Cytosine equals uracil.

33. *In Watson-Crick model of DNA:*
   A. The 2 strands are identical.
   B. One strand forms a right handed helix and the other is left handed.
   C. The ratio of (A+G) / (T+C) = 1.
   D. The hydrogen bonding between A &T and G &C is equal.

34. *If cytosine residue in DNA is deaminated into uracil residue, the mutant base may be removed by:*
   A. An endonuclease.
   B. An exonuclease.
   C. A glycosylase.
   D. DNA ligase.

35. *If the DNA sequence is: A, G, T nucleotides, the complementary mRNA will be:*
   A. T G A.
   B. A C T.
   C. T C A.
   D. U C A.

36. *Patients with xeroderma pigmentosum develop skin cancer when they are exposed to sunlight because they have a deficiency in:*
   A. An enzyme essential to repair mismatched bases.
   B. UV specific endonuclease.
   C. DNA polymerase I.
   D. DNA polymerase III.
   E. Glycosylase that removes uracil bases from DNA.

37. *Which of the following sequences in mRNA is complementary to the DNA sequence 5'-AGCCAATT-3':*
   A. 5'-AGCCAAUU-3':
   B. 5'-UCGGUUAA-3'.
   C. 5'-UUAACCGA-3'.
   D. 5'-AAUUGGCU-3'.

38. *DNA contains which one of the following components?*
   A. Nitrogenous bases joined by phosphodiester bonds.
   B. Two strands that run in the same direction.
   C. The sugar is ribose.
   D. Bases are paired by hydrogen bonding along the central axis of the molecule.
   E. The ribose-phosphodiester molecules are arranged in the interior of the molecule.

39. *The action of DNA polymerases requires:*
   A. 5'-hydroxyl group.
   B. dUTP.
   C. NAD^+ as cofactor.
   D. 3'-hydroxyl group.
   E. CTP.

40. *Euokaryotic gene that produce mRNA:*
   A. Contains Hogness box 25 bases from the start site of transcription.
   B. Contains pribnow box 10 bases from the start site of transcription.
   C. Are transcribed by RNA polymerase III.
   D. Do not contain segments that transcribed into introns.

41. *Termination of a prokaryotic transcript:*
   A. Requires a β subunit of core RNA polymerase.
   B. Requires a Rho factor.
   C. Requires releasing factors.
   D. Requires sigma subunit.
   E. Requires enhancer.

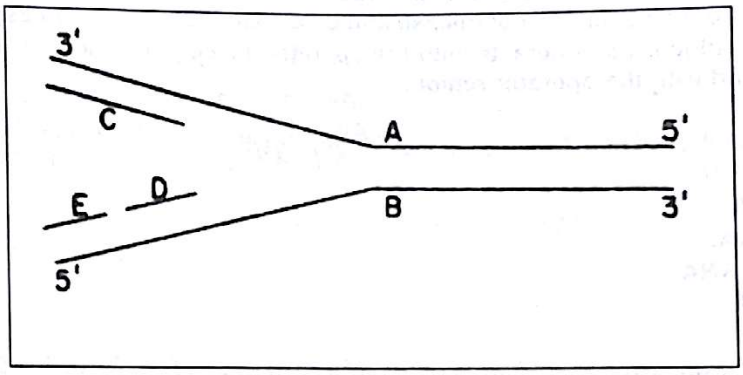
42. *All the following statements are characteristic of cloning EXCEPT:*
   A. Restriction endonuclease.
   B. Vectors.
   C. DNA donor.
   D. DNA ligase.
   E. Sg nuclease.

43. *When bases pairing occurs in loops of tRNA, adenine is hydrogen bonded to:*
   A. Guanine.
   B. Thymine.
   C. Cytosine.
   D. Uracil.

44. *All the following statements are characteristic of polymerase chain reaction (PCR) EXCEPT:*

A. The DNA sample is denatured by heat.
B. Large quantities of primers are added that bind to each DNA strand when the solution is cooled.
C. A heat stable polymerase (tag) is usually used, and polymerization is allowed to proceed through many heating and cooling cycles.
D. The heating and cooling cycles are repeated until the DNA is amplified many folds.
E. PCR cannot be used to amplify viral RNA.

In the moving replication fork shown in the figure below answer the following questions):



45. *When synthesis of segment C begins, which other segment is also being synthesized?*

A. A
B. B
C. C
D. D
E. E

46. *Segment C is synthesized:*

A. From the middle toward both ends simultaneously.
B. Towards the replication fork.
C. Awawy from the replication fork.
D. In a 3' to 5' direction.

47. *Segment E is synthesized:*

A. From the middle toward both ends simultaneously.
B. Towards the replication fork.
C. After segment D.
D. In a 3' to 5' direction.

48. *The enzyme that joins segment D and E together is:*

A. 5'-Nuclease.
B. RNA polymerase.
C. DNA ligase.
D. Repair DNA polymerase.

49. *If adenine is the first base on the template strand corresponding to the initiation point for segment E, which precursor molecule would serve as the substrate that formed the first nucleotide in segment E?*
   A. dUTP
   B. UTP
   C. dTTP
   D. TTP
   E. dTMP

50. *All the following statements about the repressor of the lac operon of E. coli are true EXCEPT:*
   A. The repressor is the product of a regulatory gene.
   B. The repressor binds to the operator region of the DNA of the lac operon.
   C. The repressor is a protein.
   D. The repressor interacts with the operator to interfere with the synthesis of ß-galactosidase, lactose permease and galactose acetylase enzymes.
   E. The inducer can interacts with the operator, making no place for the repressor to bind with the operator region.

51. *Which RNA contains 7-methylguanosine triphosphate at the 5' end?*
   A. 5 S RNA.
   B. rRNA.
   C. mRNA.
   D. 28 S RNA.
   E. tRNA.

52. *The post-transcriptional changes of tRNA involves all of the following EXCEPT:*
   A. Addition of a 7-methylguanosine triphosphate at the 5' end.
   B. Removal of introns near the anticodon sequence.
   C. Methylation of standard bases A,U,G,C.
   D. Addition of a CCA sequence at the 3' end.
   E. Reduction of size by specific class of ribonuclease.

53. *Post-transcriptional changes of mRNA include the following mechanisms EXCEPT:*
   A. Splicing.
   B. Addition of poly A tail.
   C. Glycosylation.
   D. 5' – Capping.

54. *tRNA:*
   A. Is identical to mRNA.
   B. Must exist in at least one form for each amino acid.
   C. Carries genetic code.
   D. Complementary to DNA template strand.

55. *Degeneracy of the genetic code means:*
   A. More than one codon can code for the same amino acid.
   B. The genetic code is the same for all species of plants and animals.
   C. Codons do not overlap each other.
   D. Specific codon always codes for only a single amino acids.

56. *mRNA is a complementary copy of:*
   A. A single strand of DNA.
   B. Both strands of DNA.
   C. Ribosomal RNA.
   D. tRNA.

57. *The post-translatioinal modifications of the primary proteins involve:*
   A. Phosphorylation.
   B. Glycosylation.
   C. Hydroxylation
   D. Conversion of inactive protein into active one
   E. All of the above

58. *All the following about a primary mRNA transcript in eukaryotes are correct EXCEPT:*
   A. It is usually longer than the functional mRNA.
   B. It contains exons and introns.
   C. It contains pribnow box.
   D. It is called hnRNA.

59. *Histones are:*
   A. Acidic proteins associated with DNA.
   B. Acidic proteins associated with RNA.
   C. Neutral proteins associated with RNA.
   D. Basic proteins associated with DNA.

60. *If the RNA sequence is G U A, the complementary DNA synthesized by reverse transcriptase will be:*
   A. T G C.
   B. C A T.
   C. A U G.
   D. U G C.

61. *An aminoacyl-tRNA:*
   A. Is produced by a synthetase that is very specific for both the amino acid and the tRNA.
   B. Is composed of an amino acid esterified to the 3' end of a tRNA.
   C. Requires ATP for its synthesis from an amino acid and a tRNA.
   D. Contains an anticodon that complementary to the codon for the amino acid.
   E. All of the above

62. *An intron is:*
   A. That part of protein that is removed by limited proteolysis
   B. That part of protein between sites of attachment of carbohydrate
   C. That part of tRNA molecule that is not doubled stranded
   D. The DNA segment that separates one gene from another
   E. The DNA sequences that interrupt translated sequences

63. *AUG, the only identified codon for methionin, is important as:*
   A. A chain termination codon.
   B. A chain initiating codon.
   C. A releasing factor for peptide chains.
   D. The recognition site on the transfer RNA.

64. *Complementary DNA library is:*
   A. A collection of cloned fragments that represents only the exons (or the population of mRNA in a cell)
   B. A collection of cloned fragments that represent the entire DNA content of the cell and inclueds exons and introns.
   C. A collection of restriction enzymes
   D. A collection of radioactive probes.

65. *For Lac operon, when cyclic AMP levels are relatively high in E.coli:*
   A. Lactose is not required for transcription of lactose operon.
   B. Glucose levels in the medium are low.
   C. The repressor is bound to the operator of lac operon, if lactose is present.
   D. The cyclic AMP molecules bind to operator.
   E. RNA polymerase cannot bind to promoter region.

66. *What is the major function of the 92^{o}C temperature?*
   A. It is the optimal temperature for DNA polymerization.
   B. It increases the specificity of the binding of the primers.
   C. It denatures the DNA strands
   D. It derives the polymerase reaction to completion.
   E. It reanneals newly synthesized DNA strands

67. *Genomic DNA library is:*
   A. A collection of cloned fragments that represents only the exons (or the population of mRNA in a cell)
   B. A collection of cloned fragments that represent the entire DNA content of the cell and inclueds exons and introns.
   C. A collection of restriction enzymes
   D. A collection of radioactive probes.

In the following questions indicate with clear (T) the true statements, and with clear (F) the false statements:

Telomerases:

68. Are enzymes responsible for telomeres synthesis
69. By age, they become more active, making tolemeres longer.
70. In cancer cells, tolemerases are also highly active leading to high proliferation rate.
71. Are enzymes responsible for stability of the center (centromere) of chromosomes.
72. Are enzymes responsible for synthesis of short repeats 0f TG-rich sequences.

Okazaki fragment:

73. Are produced by restriction enzymes.
74. Are synthesized mainly on the lagging strand of moving fork.
75. Are regions of DNA that do not code for the amino acids in proteins.
76. Are RNA primers.
77. Are synthesized by DNA polymerase III.

xeroderma pigmentosum:

78. Is a autosomal dominant disease.
79. Is a benign transformation of skin cells.
80. Is due to absence of UV specific endonuclease.
81. Is a disease resulting from purine dimer in DNA.

The replication of DNA:

82. Occurs during the M phase of the cell cycle..
83. Is semiconservative.
84. It proceeds in both directions, one towards the moving fork and the other away from it.
85. Requires polymerases I, II an III.

Mismatch repair:

86. Methylated bases signal the correct strand.
87. Correct the thymin-thymin dimer.
88. Needs GATC endonuclease to cut the defective strand at GATC site adjacent to the defective site.
89. Performed by polymerase III, which recognizes and removes mismatched bases during the process of replication.
90. Needs Ku and DNA-PK proteins.

For the following enzymes:

A. *DNA Polymerase I.*
B. *DNA Polymerase III.*
C. *DNA ligase.*
D. *Reverse transcriptase.*
E. *RNAase.*

91. enzyme [a] is used in RNA transcription.
92. enzymes [a and b] are are used in DNA replication.
93. enzyme [c] is one of topoisomerases.
94. enzyme [d] may be used in recombinant DNA techniques.
95. enzymes [d and e] catalyze formation of DNA strand from viral RNA.

Histones:

96. Are positively charged basic proteins rich in lysine and arginine.
97. Are a part of chromatin.
98. Are arranged in structure units called nucleosomes.
99. Are two major classes, H1 and H2.
100. Is the major constituent of spliceosomes.

The mechanism of induction and repression put by Jacob and Monod, 1961 states that:

101. There are structural genes and regulatory genes.
102. Several structural genes are active or inactive simultaneously.
103. Both inducer and repressor act by binding to operator.
104. CAP site should be free to allow RNA polymerase to bind to promotor segment.

Matching: For each set of numbered questions, choose the ONE BEST answer from the list of lettered options below it. An answer may be used once or more times, or not at all.

105. *More than one codon can code for the same amino acid.*
106. *The genetic code is the same for all species of plants and animals.*
107. *Elements of certain codons do not form parts of adjacent codon.*
108. *Specific codon always codes for only a single amino acids.*

A. Universality.
B. Degeneracy.
C. Specificity of code.
D. Nonoverlapping.

109. *Inhibits peptidyl transferase enzyme*
110. *Its structure resembels the structure of aminoacyl-tRNA*
111. *Binds to the ribosomes, distorting its structure and inhibits elongation*
112. *Inhibits euokaryotic elongation factor-2 and prevents elongation*
113. *Interacts with small ribosomal subunits and prevents aminoacyl tRNA anticodon from recognition of their corrosponding codons*

A. Streptomycin
B. Tetracyclins
C. Cholaramphincol
D. Puromycin
E. Diphtherial toxins

114. *Silent mutation.*
115. *Missense mutation.*
116. *Nonsense mutation.*
117. *Frame shift mutation.*

A. The codon containing the changed base may become a termination codon.
B. The codon containing the changed base may code for the same amino acid.
C. The codon containing the changed base may code for a different amino acid.
D. Results from either addition or deletion of one or more nucleotides.

118. *Southern blot.*
119. *Northern blot*
120. *Genetic library.*
121. *PCR*

A. Analysis of RNA species that are complementary to the probe.
B. Analysis of chromosomal DNA that are complementary to the probe.
C. A diagnostic technique for amplification of small pieces of viral DNA or RNA in serum used in diagnosis of infectious diseases.
D. A collection of a cloned fragments that represents the entire genome.

122. *A type of viruses that live in bacteria.*
123. *A large number of identical molecules, bacteria or cells arising from a common ancestor.*
124. *Extramicrosomal small circular duplex DNA molecule that give antibiotics resistance to the host cells.*
125. *A carrier part of recombinant DNA.*

A. Vector.
B. Plasmid.
C. Clone.
D. Phage.

126. *Primary mRNA that contains exons and introns.*
127. *Contains both 7 methylguanosine triphosphate, poly A tail and exons only.*
128. *Serve as adaptor molecule for translation of mRNA into protein sequence.*
129. *Bind each end of intron by forming base pair with each other.*

A. Mature mRNA.
B. SnRNA (snRNP).
C. hnRNA.
D. tRNA.

109. *Inhibits peptidyl transferase enzyme*
110. *Its structure resembels the structure of aminoacyl-tRNA*
111. *Binds to the ribosomes, distorting its structure and inhibits elongation*
112. *Inhibits euokaryotic elongation factor-2 and prevents elongation*
113. *Interacts with small ribosomal subunits and prevents aminoacyl tRNA anticodon from recognition of their corrosponding codons*

A. Streptomycin
B. Tetracyclins
C. Cholaramphincol
D. Puromycin
E. Diphtherial toxins

114. *Silent mutation.*
115. *Missense mutation.*
116. *Nonsense mutation.*
117. *Frame shift mutation.*

A. The codon containing the changed base may become a termination codon.
B. The codon containing the changed base may code for the same amino acid.
C. The codon containing the changed base may code for a different amino acid.
D. Results from either addition or deletion of one or more nucleotides.

118. *Southern blot.*
119. *Northern blot*
120. *Genetic library.*
121. *PCR*

A. Analysis of RNA species that are complementary to the probe.
B. Analysis of chromosomal DNA that are complementary to the probe.
C. A diagnostic technique for amplification of small pieces of viral DNA or RNA in serum used in diagnosis of infectious diseases.
D. A collection of a cloned fragments that represents the entire genome.

122. *A type of viruses that live in bacteria.*
123. *A large number of identical molecules, bacteria or cells arising from a common ancestor.*
124. *Extramicrosomal small circular duplex DNA molecule that give antibiotics resistance to the host cells.*
125. *A carrier part of recombinant DNA.*

A. Vector.
B. Plasmid.
C. Clone.
D. Phage.

126. *Primary mRNA that contains exons and introns.*
127. *Contains both 7 methylguanosine triphosphate, poly A tail and exons only.*
128. *Serve as adaptor molecule for translation of mRNA into protein sequence.*
129. *Bind each end of intron by forming base pair with each other.*

A. Mature mRNA.
B. SnRNA (snRNP).
C. hnRNA.
D. tRNA.

Match the numbered steps with the lettered processes:

130. *First step*
131. *Second step*
132. *Third step*
133. *Fourth step*
134. *Fifth step*

A. Formation of complex between ribosomes and mRNA.
B. Bringing of one of termination codons in A site
C. Formation of aminoacyl-tRNA.
D. Release of polypeptide chain.
E. Formation of peptide bond

135. *Carrier of amino acids to the site of protein synthesis*
136. *Possesses property of self -replication*
137. *Contains peptidyl transferase enzyme*
138. *Carrier of genetic information from DNA to the site of protein synthesis*

A. DNA
B. tRNA
C. mRNA
D. ribosomes

139. *Catalyzes first step of protein synthesis*
140. *Catalyzes formation of mRNA*
141. *Catalyzes formation of peptide bond*
142. *Contains the information for protein synthesis*
143. *Requires 3'-hydroxyl group*

A. Peptidyl transferase
B. DNA polymerase
C. Amino acyl tRNA synthetase
D. mRNA
E. DNA-dependant RNA polymerase

144. *Proofreading and repair of DNA.*
145. *Mitochondrial DNA synthesis.*
146. *Remove RNA primers and fill the gaps that left between Okazaki fragment.*
147. *DNA repair.*
148. *Synthesis of leading and Okazaki fragments.*

A. α -Polymerase.
B. β- Polymerase.
C. γ- Polymerase.
D. δ- Polymerase.
E. ε- Polymerase.

149. *Miss match repair.*
150. *Thymin-thymin dimer repair.*
151. *Double stranded break repair.*
152. *Base excesion repair (deamination of cytosine into uracil).*

A. Glycosylase.
B. UV specific endonuclease.
C. KU and DNA-PK proteins .
D. Methylation of the correct strand and GATC endonuclease.

153. *DNA polymerase.*
154. *RNA polymerase.*
155. *DNA ligase.*
156. *Reverse transcriptase.*

A. Used by retroviruses to copy their RNA genome.
B. Used by nucleotides containing uracil as a precursor.
C. Initiates the synthesis of DNA polynucleotide strands.
D. Seals the gaps between 2 polynucleotide chains.

157. *Nucleosome.*
158. *Primosome.*
159. *Ribosome.*
160. *Spliceosome.*

A. hnRNA, SnRNA and proteins.
B. rRNA and proteins.
C. RNA polymerase and a helicase protein.
D. DNA and histones.

161. *hnRNA.*
162. *mRNA.*
163. *rRNA.*
164. *snRNA.*
165. *tRNA.*

A. Contains both cap and a poly A tail.
B. Transcribed as 45 S large precursor.
C. Has a role in splicing of introns.
D. A primary mRNA molecule.
E. Modified by addition of CCA nucleotides at 3' end.

166. *Introns.*
167. *Exons.*
168. *Poly A tail.*
169. *7-Methylguanosine triphosphate.*

A. Protect mRNA from 3'-exonuclease.
B. Protect mRNA from 5'-endonuclease and facilitate initiation of translation.
C. Removed from transcripts by splicing process.
D. Codes for amino acids in protein.

Answer Key

MCQ:

1	2	3	4	5	6	7	8	9	10
B	B	A	B	B	C	A	D	C	B
11	12	13	14	15	16	17	18	19	20
A	B	A	D	A	C	B	A	B	A
21	22	23	24	25	26	27	28	29	30
E	D	D	B	D	C	C	D	C	B
31	32	33	34	35	36	37	38	39	40
E	A	C	C	D	B	D	D	D	A
41	42	43	44	45	46	47	48	49	50
B	E	D	E	D	B	C	C	C	E
51	52	53	54	55	56	57	58	59	60
C	A	C	B	A	A	E	C	D	B
61	62	63	64	65	66	67			
E	E	B	A	B	C	B			

True and false:

68	69	70	71	72	73	74	75	76	77
T	F	T	F	T	F	T	F	F	T
78	79	80	81	82	83	84	85	86	87
F	F	T	F	F	T	T	T	T	F
88	89	90	91	92	93	94	95	96	97
T	F	F	F	T	F	T	T	T	T
98	99	100	101	102	103	104			
T	F	F	T	T	F	F			

Matching:

105	106	107	108	109	110	111	112	113	114
B	A	D	C	C	D	A	E	B	B
115	116	117	118	119	120	121	122	123	124
C	A	D	B	A	D	C	D	C	B
125	126	127	128	129	130	131	132	133	134
A	C	A	D	B	C	A	E	B	D
135	136	137	138	139	140	141	142	143	144
B	A	D	C	C	E	A	D	B	E
145	146	147	148	149	150	151	152	153	154
C	A	B	D	D	B	C	A	C	B
155	156	157	158	159	160	161	162	163	164
D	A	D	C	B	A	D	A	B	C
165	166	167	168	169					
E	C	D	A	B					

Chapter 9

Cell membranes, Structure and Functions

1. *What is the function of Golgi complex?*

   A. Maturation and processing of nascent proteins, glycosylation of proteins, secretion of newly synthesized proteins.

2. *What is the function of endoplasmic reticulum?*

   A. Biosynthesis of proteins, drug metabolism, desaturation of fatty acids.

3. *What is the marker enzyme for endoplasmic reticulum?*

   A. Glucose-6-phosphatase.

4. *Where does protein synthesis take place?*

   A. On the walls of endoplasmic reticulum and also in cytosol.

5. *What are cathepsins?*

   A. They are intracellular proteolytic enzymes.

6. *What is the function of lysosomes?*

   A. They are bags of hydrolytic enzymes that bring about degradation of macromolecules.

7. *What is lysozyme?*

   A. It is an enzyme present in external secretions.

8. *What are peroxisomes?*

   A. Cell organelles contain peroxidase and catalase, necessary for destroying the unwanted free radicals(H_2O_2).

9. *What are the important metabolic events taking place in cytosol?*

   A. Glycolysis, pentose phosphate pathway, glycogen metabolism, fatty acid synthesis, synthesis of necleotides, degradation of amino acids.

10. *What is the function of mitochondria?*

    A. Generation of ATP.

11. *What are the important metabolic events taking place in mitochondria?*

    A. TCA cycle, electron transport chain, beta oxidation of fatty acids and urea cycle.

12. *What are the ecto-enzymes?*

    A. They are enzymes seen on the outer part of cell membrane.

13. *Give examples of ecto-enzymes.*

A. Alkaline phosphatase, and 5'nucleotidase.

14. *What are functions of cell membranes?*

A. Structural functions and metabolic functions.

15. *What are structural functions of cell membranes?*

A. They form enclosed compartment around cells and organelles separating them from external environment.

16. *What are metabolic functions of cell membranes?*

A. (1) Membranes contain specific molecular pumps and gates, (2) specific receptors e.g. insulin receptors, (3) some membranes generate signals, which may be chemical or electrical, (4) membranes are the site of energy production e.g. ATP production by oxidative phosphorylation in the inner mitochondrial membrane.

17. *What are the components of cell membranes?*

A. Lipids, proteins, and carbohydrate.

18. *What are the lipid components of cell membranes?*

A. Phospholipids, glycolipids and cholesterol.

19. *What are the main lipid components of cell membranes?*

A. Phospholipids.

20. *What are types of phospholipids of cell membranes?*

A. They are either glycerophospholipids (as lecithin) or sphingo-phospholipids as sphingomyelin .

21. *What are other lipid components of cell membranes?*

A. Glycolipids as cerebrosides, gangliolipids and Cholesterol which is present mainly in plasma membrane and with lesser amount in mitochondria and nucleus.

22. *What are the proteins components of cell membranes?*

A. Membrane proteins are of two types; *peripheral* (weakly bound to surfaces of integral proteins and they can be removed easily by salt solution) and *Integral* (Deeply embedded in lipid bilayer and attached strongly by Van Der Waals forces. They are removed only by detergents).

23. *What are functions of membrane proteins?*

A. (1) Transport of substances and communications. (2) Cell membrane receptors are membrane proteins. (3) Immunoglobulins are integral proteins of the membranes of lymphocytes. (4) Many enzymes are membrane bound. (5) Proteins of mitochondrial membrane are essential for energy production (ATP). (6) Erythrocyte membrane proteins have important functions.

24. *How do you describe the structure of cell membrane?*

A. Fluid mosaic model.

25. *What are the charactaristics of fluid mosaic model?*

A. Membrane is composed of phospholipids bilayer with a hydrophobic core. Membrane phospholipids act as a solvent for membrane proteins forming an environment in which protein can function. Most membrane proteins have 2 hydrophilic ends separated by a hydrophobic region which traverses the hydrophobic core of the phospholipids bilayer. This gives what is called fluid mosaic model.

26. *Describe lipid bilayer of membranes?*

A. Lipids have polar head and nonpolar tail group i.e. they are amphipathic. In aqueous solution, membrane phospholipids are arranged in bilayer form, where the polar groups are arranged outside, while nonpolar groups are arranged inside. Fatty acids content of phospholipids are either saturated with straight tails or unsaturated with kinked tail. The more kinks present, the more fluidity of the membrane.

27. *What do you mean by fluidity of the membrane?*

A. It is the free lateral movement of the lipid bilayer components.

28. *What are the components of membrane that alter the fluidity?*

A. Cholesterol and unsaturated fatty acids.

29. *What are factors affecting fluidity of the membrane?*

A. Fluidity depends on both temperature and lipid contents. The more temperature, the more fluidity. The more unsaturated fatty acids, the more fluidity. The more cholesterol content, the more fluidity in the hydrophobic core and less fluidity in the hydrophilic core.

30. *What is membrane asymmetry?*

A. It means that lipid components of each half of lipids bilayer are different from the other. Also, carbohydrates and proteins are irregularly distributed

31. *What are causes of membrane asymmetry?*

A. (1) Phospholipids containing choline are located mainly in the outer layer, while phospholipids containing amino group (e.g. phosphatidyl serine) are located mainly in the inner layer. (2) Carbohydrate content are located mainly in the outer layer. (3) Protein content are irregularly distributed in the membrane. Many proteins e.g. hormones receptors are located in the outer layer.

32. *What are types of erythrocyte membrane proteins?*

A. Ankyrin, spectrin, glycophorin and anion channel proteins

33. *What are functions of ankyrin and spectrin?*

A. They are peripheral proteins bound together within the red cell membrane. They maintain the biconcave shape of red cells.

34. *What is the dieases resulting from mutation of gene of spectrin?*

A. Hereditary spherocytosis where there is loss of biconcave shape of red cells.

35. *What are functions of glycophorin?*

A. It is a glycoprotein of red cell membrane (60% carbohydrate). It constitutes the blood group substances, and gives red cells a very hydrophilic charged coat which enables them to circulate without adhering to other cells on vessel walls.

36. *What are functions of anion channel proteins?*

A. It consists of 2 identical subunits. It plays an important role in transport of CO_2 via blood.

37. *What are the carbohydrate components of cell membranes?*

A. They are present in the form of glycoproteins and glycolipids. They are located on the external surface of cell membrane.

38. *What are the different types of transport mechanisms?*

A. Passive and active transport for transfer of small molecules. Endocytosis and exocytosis for transport of large molecules.

39. *What are the features of passive simple diffusion?*

A. Substances move from higher to lower concentration i.e. according to concentration gradient. It needs no energy. The rate of transport depends on solubility of the transported molecules in the hydrophobic core of the membrane.

40. *What are ion channels?*

A. They are special protein containing pores for quick transport of electrolytes.

41. *Give some examples of ion channels.*

A. Ion channels specific for calcium, potassium and chloride.

42. *What are the features of facilitated diffusion?*

A. Facilitated diffusion differs from passive diffusion in that it can be saturated i.e. diffusion stops when all carriers are saturated with transported molecules. It does not require energy directly.

43. *Can you give an example of facilitated transport?*

A. Glucose transporters-5 (Glu-5).

44. *What are the features of active transport?*

A. Active transport means that substances move from lower concentration to higher concentration. It requires transporters and energy. Transport is generally unidirectional.

45. *What is the sources of energy for active transport?*

A. Sodium-potassium pump, with hydrolysis of ATP in the presence of ATPase enzyme. This enzyme is a part of cell membrane proteins.

46. *Give examples of active transport systems.*

A. Sodium pump, calcium pump.

47. *What is the importance of sodium pump?*

A. Cell has low intracellular sodium; but concentration of potassium inside the cell is high; this is maintained by sodium pump. About 40% of the total energy expenditure in a cell is used for this active transport system.

48. *How does sodium pump work?*

A. It is called sodium-potassium activated ATPase. Hydrolysis of one molecule of ATP can result in expulsion of 3 sodium ions and influx of 2 potassium ions.

49. *What is its clinical significance?*

A. Digoxin increases the contractility of the cardiac muscle, by inhibiting the sodium pump.

50. *What is endocytosis?*

A. It is the mechanism by which cells internalize extracellular macromolecules.

51. *What are types of endocytosis?*

A. Pinocytosis and Phagocytosis.

52. *What is pinocytosis?*

A. It is receptor mediated. Low Density lipoprotein (LDL) binds to the LDL receptor and the complex is later internalized. These vesicles are coated with Clathrin.

53. *What is phagocytosis?*

A. It is the engulfment and internalization of large particles such as bacteria by macrophages and granulocytes.

54. *What is respiratory burst?*

A. During phagocytosis, there is an increase in oxygen consumption with formation of the superoxide ion.

55. *What does exocytosis mean?*

A. It is an opposite process of endocytosis. It is used to release macromolecules made in the endoplasmic reticulum and Golgi apparatus to the outside of the cell e.g. release of insulin hormone from β-cells of islets of Langerhans in pancreas.

56) *What are ionophores?*

A. They are transport antibiotics which increase the permeability of membrane to ions, e.g. valinomycin, gramicidin.

57. *What is a uniport?*

A. It carries single solute across the membrane.

58. *Give examples of uniport.*

A. Glucose transporter (GluT2) operating in most of the cells is an example. Calcium pump is another example.

59. *What is co-transport?*

A. If transfer of one molecule depends on simultaneous or sequential transfer of another molecule, it is called co-transport system.

60. *How are co-transport systems classified?*

A. The co-transport system may be symport or antiport.

61. *What is symport?*

A. In symport, the transporter carries two solutes in the same direction across the membrane.

62. *Give examples of symport.*

A. Sodium dependent glucose transporter (SgluT). Phlorhizin, an inhibitor of sodium-dependent cotransport of glucose, especially in the proximal convoluted tubules of kidney, produces renal damage and results in renal diabetes. Amino acid transport is another example for symport.

63. *What is antiport system?*

A. The antiport system carries two solutes or ions in opposite direction.

64. *Give examples of antiport.*

A. Sodium pump or chloride-bicarbonate exchange in RBC.

MCQ, Matching, true and false and Completion

Select and encircle the most appropriate answer or completion:

1. *The following are functions of plasma cell membrane EXCEPT:*
   A. It contains specific receptors.
   B. It is site of energy (ATP) production by oxidative phosphorylation.
   C. It contains specific pumps and gates.
   D. It separates cell organelles from external environment.

2. *Phospholipids are important cell membrane constituents because:*
   A. They are amphoteric molecules.
   B. They are amphipathic molecules.
   C. They contain glycerol.
   D. They contain saturated fatty acids.

3. *Which statement about causes of cell membrane asymmetry is INCORRECT:*
   A. Carbohydrates content are located mainly in the inner layer.
   B. Phospholipids containing choline are located mainly in the outer layer.
   C. Phospholipids containing serine are located mainly in the inner layer.
   D. Proteins content are irregularly distributed in the membrane.

4. *Ankyrin and spectrin are:*
   A. Antioxidants rich in vitamin E.
   B. Substances that cause hyperuricemia.
   C. Receptors for nonsteroidal hormones.
   D. Erythrocyte membrane proteins that maintain its biconcavity.

5. *Glycophorin is:*
   A. Blood anticoagulant.
   B. Cell membrane glycoprotein.
   C. Cell membrane lipids.
   D. A milk protein.

6. The following are mechanisms for transfer of small molecules across cell membrane EXCEPT:
   A. Endocytosis and exocytosis.
   B. Passive simple diffusion.
   C. Facilitated simple diffusion.
   D. Active transport that needs energy.

7. *Biological membrane proteins may function as:*
   A. Receptors
   B. Ionic chanels
   C. Enzymes
   D. All of the above

Answer Key

MCQ:

1	2	3	4	5	6	7	
B	B	A	D	B	A	D	

Notes

Chapter 10 Detoxification and Biotransformation of Xenobiotics

1. *What are xenobiotics?*
   A. They are compounds foreign to the body. They are accidentally ingested or taken. They include drugs, insecticides, carcinogenic chemicals, pollutants and certain endogenous compounds as steroids.
2. *What are phases of metabolism of xenobiotics?*
   A. Phases I and II. They aim to eliminate toxic effects of xenobiotics.
3. *What is the mechanism of phase one of metabolism of xenobiotics?*
   A. Hydroxylation of xenobiotics, which increases their polarity, solubility and excretion.
4. *Where does phase one occur?*
   A. Liver mostly in the endoplasmic reticulum (ER) is the main organ for xenobiotics metabolism.
5. *What are enzymes responsible for phase one of metabolism of xenobiotics?*
   A. They are called monooxygenase or cytochrome P-450 species. There are two types, *mitochondrial* which inactivates O_2 molecules and *microsomal* which hydroxylates xenobiotics.
6. *What are fate of products of phase one of metabolism of xenobiotics?*
   A. The polar hydroxylated xenobiotics produced in phase I are conjugated, acetylated or methylated in phase 2 to give more soluble and less toxic compounds that easily excreted in urine or bile.
7. *What are mechanisms of phase II of metabolism of xenobiotics?*
   A. Conjugation, acetylation and methylation:
8. *What are conjugation reactions of phase II?*
   A. These include reaction of xenobiotics with glucuronic acid, active sulfate and glutathione.

9. *What is glucuronidation?*

A. Addition of glucuronic acid to xenobiotics. UDP-glucuronic acid is the gluuronyl donor. The enzyme involved is UDP-glucuronyl transferase.

10. *What are xenobiotics inactivated by glucuronidation?*

A. Bilirubin, aniline, benzoic acid, some carcinogens and many steroids are conjugated and excreted as glucuronides.

11. *What are xenobiotics inactivated by sulfation?*

A. Some alcohols, phenols, steroids, glycolipids and glycoproteins are sulfated.

12. *What is sulfate donor?*

A. active sulfate (adenosine -3'- phosphate - 5' -phosphosulfate).

13. What are xenobiotics inactivated by glutathione (G-SH)?

A. Some toxic drugs and carcinogens.

14. *What is the enzyme needed for glutathione?*

A. Glutathione-S-transferase enzyme that is present in high concentration in liver cytosol.

15. *What is the importance of conjugation with glutathione?*

A. If the toxic xenobiotics were not conjugated to G-SH, they would be free to combine covalently with DNA, RNA or cell protein and lead to serious cell damage.

16. *What is acetylation?*

A. is the addition of acetyl group to the xenobiotics.

17. *What is the enzyme needed for acetylation?*

A. Acetyl transferase.

18. *What is acetyl donor?*

A. Acetyl CoA present in cytosol of various tissues especially liver.

19. *What is methylation?*

A. is the addition of methyl (-CH3) group to the xenobiotics.

20. *What is the enzyme needed for methylation?*

A. Methyl transferase.

21. *What is methyl donor?*

A. S-Adenosyl methionine

22. *What are toxic effects of xenobiotics:*

A. Cell injury, antibodies formation, and carcinogenesis.

23. *What is the mechanism of cell injury?*

A. By covalent binding of xenobiotics to cellular protein, DNA or RNA. This may stop the cellular function.

24. *What is the mechanism of antibody formation?*

A. Xenobiotics may combine with some cellular proteins forming complex. This complex will stimulate the formation of antibodies against cells of the body leading to cellular injury.

25. *What are epoxides?*

A. Certain monooxygenases react with some xenobiotics forming compounds called epoxides. Epoxides are carcinogenic.

26. *How are epoxides inactivated?*

A. They are converted into less reactive, non-carcinogenic compounds called dihydrodiol by the action of epoxide hydrolase enzyme.

27. *Where is epoxide hydrolase enzyme present?*

A. It is present in the membrane of endoplasmic reticulum (ER) of liver and other tissues.

28. *What is cytochrome P-448?*

A. Is other species of cytochrome P-450. They hydroxylate pre-carcinogens as polycyclic aromatic hydrocarbons, which are present in tobacco of cigarettes and inhaled by smoking.

29. *What is the other name of cytochrome P-448?*

A. Aromatic hydrocarbon hydroxylase

30. *Why is the name 448?*

A. Because it has high absorption peak at wave length 448 nanometers.

31. *What is detoxification process?*

A. Biochemical processes whereby noxious substances are rendered less harmful or more water soluble and easily excretable.

32. *Give an example of a substance detoxified by reduction.*

A. Paranitro-phenol.

33. *Give examples of substances detoxified by hydrolysis.*

A. Aspirin to salicylic acid + acetate.

34. *Give names of conjugating agents.*

A. PAPS, UDP glucoronic acid, glutathione, and glycine.

35. *Give some examples of substances detoxified by conjugation.*

A. Billirubin to billirubin glucoronide, phenol to phenyl sulfate, and benzoic acid to hippuric acid.

36. *give examples of amino acids that used for detoxification?*

A. Glutamine, glycine, and cysteine.

37. *Give examples of substances detoxfied by sulfation.*

A. Phenol to phenyl sulfate, and indole to indoxyl sulfate.

38. How benzoic acid is detoxified?

A. Benzoic acid + glycine = benzoyl glycine (hippuric acid).

39. What is the most common environmental poison?

A. Lead.

40. What are common causes of lead poisoning?

A. Paint, lead containing petrol, lead pipes, news papers, xerox copies and ciggarette smoke are important contaminants.

41. What are the occupations in which persons are prone to get lead poisoning?

A. Battery repair, radiator repair, soldering, painting and printing.

42. What is the toxic level of lead?

A. Blood level of lead, more than 10 mg / dl in children and more than 25 mg / dl in adults lead to toxic manifestations.

43. What are the manifestations of chronic lead poisoning?

A. Miscarriage, stillbirth, and premature birth. In children, mental retardation, learning disabilities, behavioral problems, hyperexcitability and seizures are seen. Anemia, abdominal colic and loss of appetite are very common.

44. What are the manifestation of acute lead poisoning?

A. Encephalopathy, convulsions, mania, neuropathy, abdominal colic, severe anemia and kidney damage, discolouration and blue line along the gums.

45. When does acute toxicity is manifested?

A. If the blood level of lead is more than 70 mg / dl, acute toxicity is manifested.

46. What is the cause of anemia in lead poisoning?

A. Lead inhibits delta amino levulinic acid (ALA) synthase, ALA-dehydratase and ferrochelatase. So, heme synthesis is blocked. Life span of RBC is shortened. Anemia enhances lead absorption, lead in turn produces more anemia, thus a vicious cycle is operating.

47. What are the antibodies for lead poisoning?

A. Calcium dodecyl edetate (Calcium disodium versenate), penicillamine and dimercaprol (BAL) are used as antidotes. Dimercaptosuccinic acid is a better but costly antidote.

MCQ, Matching, True and False and Completion

Select and encircle the most appropriate answer or completion:

1. *All of the following are correct about a cytochrome P450 EXCEPT:*
   A. It contains heme as a prosthetic group
   B. It catalyzes the hydroxylation of a hydrophobic substrate
   C. It may accept electrons from a substance such as $NADPH+H^+$
   D. It undergoes a change in the heme iron upon binding a substrate
   E. It comes from the same gene family as all other molecules of cytochrome P450

2. *NADPH+H+- cytochrome P450 reductase:*
   A. Use both FAD and FMN as prosthetic groups
   B. Is found in mitochondria
   C. Requires an iron-sulfur center for activity
   D. Always passes its electrons to cytochrome b_5
   E. Can use $NADH+H^+$ as readily as $NADPH+H^+$

3. *Many xenobiotics are oxidize by Cytochrome P450 in order to:*
   A. Make them carcinogenic
   B. Increase their solubility in an aqueous environment
   C. Enhance their deposition in adipose tissue
   D. Increase their pharmacological activity
   E. All of the above

4. *Concerning cytochrome P_{448}:*
   A. It hydroxylates pre-carcinogens as polycyclic aromatic hydrocarbons
   B. It hydroxylates pre-carcinogens present in tobacco of cigarettes and inhaled by smoking.
   C. Its other name is aromatic hydrocarbon hydroxylase
   D. It has high absorption peak at wave length 448 nanometers.
   E. All of the above

5. *All of the following are correct about Glucuronidation EXCEPT:*
   A. It is phase I of xenobiotics metabolism
   B. Is the addition of glucuronic acid to xenobiotic.
   C. UDP-Glucuronic acid is the glucuronyl donor.
   D. The enzyme involved is UDP-glucuronyl transferase.
   E. Bilirubin, aniline, benzoic acid are conjugated and excreted as glucuronides.

Answer Key

MCQ:

1	2	3	4	5
E	A	B	E	A

Notes

Chapter 11

Energy Metabolism

Nutrition and Digestion

1. *What is the caloric value of carbohydrates?*

   A. Four kilocalories per gram (4 Kcal/g).

2. *What is the calorific value of fats?*

   A. 9 Kcal/g.

3. *How much calories are generated per gram of fat?*

   A. 9 kCal.

4. *What is the respiratory quotient?*

   A. It is the ratio of carbon dioxide produced to the oxygen consumed.

5. *What is the respiratory quotient of carbohydrates?*

   A. One.

6. *What is the respiratory quotient of proteins?*

   A. 0.81.

7. *What is the respiratory quotient of fats?*

   A. 0.71.

8. *What.is the respiratory quotient for a mixed diet?*

   A. About 0.82.

9. *What is specific dynamic action?*

   A. Increased heat production after food intake.

10. *Which foodstuff has maximum specific dynamic action?*

    A. Proteins.

11. *Basal metabolic rate is increased in which conditions?*

    A. Fever, starvation, cold climate, and increased thyroid hormones.

12. *Increased basal metabolic rate is observed in which clinical condition?*

    A. Hyperthyroidism (Grave's disease).

13. *What is the importance of fibers in diet?*

A. Increased water retention and intestinal motility, decreased absorption of cholesterol, increased glucose tolerance and decreased incidence of cancers.

14. *What is the importance of increased motility of intestine?*

A. It produces larger and softer feces.

15. *Name an undigestible carbohydrate.*

A. Pectin.

16. *Which foodstuff contains polyunsaturated fatty acids?*

A. Vegetable oils as sunflower oil, and groundnut oil.

17. *Name some essential fatty acids.*

A. Linoleic acid, linolenic acid, and arachidonic acid.

18. *What is the dietary advice for a patient with hypercholesterolemia?*

A. They should take polyunsaturated fatty acids.

19. *What foodstuffs contain cholesterol?*

A. Egg yolk, liver, brain, butter and pig fat.

20. *A patient with coronary artery disease is advised not to eat what?*

A. Egg.

21. *What is the recommended daily allowance of protein of a normal adult?*

A. 1 g / kg.

22. *Negative nitrogen balance is observed in which conditions?*

A. Chronic infections, old age, malnutrition and hyperthyroidism.

23. *Positive nitrogen balance is observed in which conditions?*

A. Pregnancy, convalescence, and growth period.

24. *Phenyl alanine is deficienct in which foodstuff?*

A. Maize.

25. *Methionine is deficient in which foodstuff?*

A. Cereals.

26. *How all amino acids are made available in a mixed diet?*

A. Supplementation by combining all types of cereals.

27. *What are the features of Kwashiorkor?*

A. Hypoalbuminemia, ↓ magnesium , growth retardation, edema, and loss of appetite.

28. *How much energy is required for a 60 kg person, with sedentary work?*

A. 2000 kCal.

29. *A balanced diet should have calories for carbohydrate, proteins and fats in which ratio?*

A. 60: 20: 20.

30. *What is the importance of dietary lipids?*

A. Energy production, supply fat soluble vitamins A, D, K and E, supply essential fatty acids, eicosanoids and make food more palatable.

31. *What foodstuffs contain cholesterol?*

A. Egg, butter, ghee, and pig fat.

32. *What are the importance of dietary proteins?*

A. Synthesis of body proteins and other nitrogen containing compounds as purines, pyrimidines and heme.

33. *What do essential amino acids mean?*

A. Are amino acids, which cannot be synthesized by the body tissues, and should be taken in diet.

34. *What are essential amino acids?*

A. Isoleucine, leucine, tryptophan, methionine, valine, threonine, lysine, and phenylalanine.

35. *What are semi-essential amino acids?*

A. Histidine, and Arginine.

36. *What do semi-essential amino acids mean?*

A. Are amino acids, which can be synthesized by the tissues, but in amounts not sufficient for pregnancy and growing children.

37. *What are factors determining the quantity of protein required?*

A. Protein quality, energy intake, and physical activity.

38. *What about protein quality?*

A. Proteins of high biological value is better than other proteins.

39. *What about energy intake and physical activity?*

A. If the energy required by the body is derived from carbohydrate and lipids, this spares the use of proteins as an energy source. Physical activity increases nitrogen retention from dietary protein.

40. *What is the importance of dietary carbohydrates?*

A. They serve as a source of energy and they form structural elements in cells. Carbohydrates may combine with lipids (glycolipids) or protein (glycoproteins); both enter in the structure of cell membrane and form the ground substances between tissues. Cellulose fibers make stool bulky and prevent constipation.

41. What is the importance of vitamins in diet?

A. Vitamin B group act mainly as coenzymes, vitamin C is important for collagen formation, act as antioxidant, and keep metal cofactors (e.g. iron, copper) in reduced state. The fat-soluble vitamins have a variety of functions e.g. vitamin A is important for vision, vitamin D is important for calcium and phosphorus metabolism, vitamin K is important for clotting and vitamin E act mainly as antioxidant.

42. What are types of salivary glands?

A. There are 3 pairs of salivary glands: parotid, submixillary and sublingual.

43. What is the composition of saliva?

A. Water 99% and solids 1% (2/3 organic substances & 1/3 inorganic substances). The organic substances include salivary amylase, mucin and lysozyme. The inorganic substances include calcium, potassium, sodium, magnesium, sulfate, phosphate, bicarbonate and chloride.

44. What is the functions of saliva?

A. (1) It moistens the mouth and helps speech, it moistens the food and helps swallowing, (2) It keeps the mouth clean, (3) digestion (salivary amylase acts on cooked starch converting it into maltose), (4) Antibacterial action (lysozyme is an enzyme that can kill bacteria, (5) Excretory action (mercury, lead and iodine may be excreted with saliva in the mouth) and (6) buffering action (saliva contains bacteria and phosphate buffers which prevents the effect of acids on teeth).

45. What is the composition of gastric secretion?

A. 99% water and 1% solids (2/3 are organic and 1/3 are inorganic substances). The organic substances include enzymes as pepsin, rennin, lipase, intrinsic factor and mucin. The inorganic substances include potassium, sodium, hydrogen and chloride.

46. What is the functions of gastric secretion?

A. (1) Digestion (pepsin, rennin and lipase enzymes), (2) intrinsic factor, which is a glycoprotein essential for vitamin B_{12} absorption, (3) Mucin that covers the inner surface of gastric mucosa, thus it protects the mucosa from proteolytic effect of gastric enzymes and HCl.

47. What are the functions of HCl?

A. (1) It activates pepsinogen into pepsin and it gives an optimum pH for pepsin action, (2) Antibacterial action as it kills bacteria

and parasites, (3) It helps iron and calcium absorption and (4) it stimulates the secretion of *secretin* hormone from the duodenum.

48. *What is the composition of intestinal juice (succus entericus)?*

A. 98% water and 2% solids (2/3 are organic and 1/3 are inorganic substances). The organic substances include mucin and enzymes as disaccharidases (maltase, sucrase & lactase), amino peptidase, intestinal lipase and nucleotidases & nucleosidases. The inorganic substances include calcium, potassium, sodium, phosphate and chloride.

49. *What is the function of intestinal juice (succus entericus)?*

A. Digestion of carbohydrate, protein, and lipids.

50. *What is the composition of pancreatic juice?*

A. It is composed of inorganic and organic substances. Inorganic substances as Ca^{2+}, K^{+}, Na^{+}, HCO_3^{-}, Cl^{-}, PO_4^{-3} etc. HCO_3^{-} content is the cause of its alkalinity. Organic substances as mucin and enzymes.

51. *What are pancreatic enzymes?*

A. (1) Enzymes acting on carbohydrates as pancreatic amylase, (2) Enzymes acting on lipids as pancreatic lipase, cholesterol esterase and phospholipases, (3) Enzymes acting on proteins as trypsin, chymotrypsin and carboxypeptidase and (4) Enzymes acting on nucleotides as nucleotidases and nucleosidases.

52. *What is the composition of bile?*

A. 97% water and 3% solids (organic and inorganic substances). The organic substances include bile acids (Na glycocholate and Na taurocholate), bile pigments (bilirubin and biliverdin), mucin, cholesterol, esterified and non esterified fatty acids and alkaline phosphatase enzyme. The inorganic substances include mainly bicarbonates.

53. *What is the nature of bile acids?*

A. Steroid in nature.

54. *What are primary and secondary bile acids?*

A. Primary bile acids are cholic and chenodeoxy cholic acid. Secondary bile acids are deoxycholic acid and lithocholic acid.

55. *What is the difference between primary and secondary bile acids?*

A. Secondary bile acids have no –OH group at 7 carbon.

56. *What are functions of bile acids?*

A. Digestion and absorption of lipids, anti-putrefactive action, and choleretic action.

57. *How bile acids help digestion and absorption of lipids?*

A. Bile acids in the form of bile salts help the emulsification of lipids i.e. breakdown of large molecules into small ones. This increases the surface area upon which digestive enzymes act. For absorption of lipids, bile salts together with lipid forming the water soluble micelles. This helps the absorption of lipids.

58. *Why bile acids have anti-putrefactive action?*

A. Bile acids inhibit the multiplication of pathogenic intestinal bacteria.

59. *What is choleretic action?*

A. Any substance increases bile production is choleritic. Bile acids are absorbed again to the liver (by enterohepatic circulation) and stimulate the bile production.

60. *What is alkaline tide?*

A. This is alkalinity of urine after meal. After meal, HCl formation increases → Excess bicarbonate in blood, which is excreted by the kidneys in the urine → alkalinity of urine.

61. *What is the name of bacterial actions on proteins, carbohydrate, and lipids?*

A. Bacterial actions on proteins = putrifaction, bacterial actions on carbohydrate = fermentation and bacterial actions on lipids = rancidity.

62. *What is of putrifaction?*

A. It is decomposition of proteins and amino acids by intestinal bacteria. It leads to offensive odor.

63. *What are effects of putrifaction?*

A. It leads to conversion of tryptophan into indole and skatole, cysteine into ethyl mercaptan (CH_3-CH_2-SH). It leads also to production of amines (as tryptamine, and histamine), phenols and toxic gases as ammonia (NH_3), hydrogen sulfide (H_2S) and CO_2.

64. *What is fermintation?*

A. It is decomposition of carbohydrates by intestinal bacteria. It leads to production of CO_2 and lactic acid.

65. *What is alcoholic fermintation?*

A. Glucose fermentation by bakers yeast result in production of CO_2 and ethanol.

66. *What is rancidity?*

A. It is decomposition of lipids by oxygen of the air, moisture or bacteria. It leads to change in odor and taste of fats, with

formation of epoxides and peroxides of small molecular weight fatty acids.

67. ***What are gastric enzymes?***

A. Pepsin, rennin and gastric lipase.

68. ***Enumerate hormones regulating gastrointestinal enzymes?***

A. Gastrin, cholysystokinin, pancreozymin and secretin.

69. ***What is the site of gastrin production ?***

A. Gastric antrum.

70. ***What are the action of gastrin, cholysystokinin, pancreozymin and secretin?***

A. Gastrin, stimulate secretion of pepsinogen and intrinsic factor from gastric mucosa, cholysystokinin and pancreozymin stimulate secretion of pancreatic enzymes and contraction of the gall bladder and secretin stimulates secretion of pancreatic bicarbonate and help the action of cholysystokinin and pancreozymin hormones.

71. ***How carbohydrates be digested?***

A. See chapter of questions on carbohydrate metabolism.

72. ***How lipids be digested?***

A. See chapter of questions on lipids metabolism.

73. ***How proteins be digested?***

A. See chapter of questions on protein metabolism.

MCQ, Matching, True and False and Completion

Select and encircle the most appropriate answer or completion:

1. *Oxidation of which substance yields the most calories per gram?*
   A. Lipid
   B. Plant protein
   C. Animal protein
   D. Glucose
   E. Glycogen

2. *A negative nitrogen balance is observed:*
   A. During normal pregnancy
   B. During normal child growth
   C. During convalescence
   D. In malnutrition
   E. None of these

3. *The biological value of a given protein depends upon:*
   A. The digestibility alone
   B. Digestibility and amino acid composition
   C. Amino acid composition alone
   D. Amino acid composition and specific dynamic effect
   E. Digestibility and leucine content

4. *An important etiological factor in kwashiorkor is:*
   A. Steatorea
   B. Atrophy of acinar tissue of pancreas
   C. Anemia
   D. Dietary protein deficiency
   E. Excess dietary proteins

5. *A sensitive enzyme test for determining the biological value of proteins is measurement of:*
   A. Liver xanthine oxidase
   B. Pepsin activity of gastric juice
   C. Serum transaminase
   D. Pancreatic amylase
   E. Serum lipoprotein lipase

6. *The ingestion of which foodstuff results in the greatest specific dynamic action?*
   A. Fat
   B. Carbohydrate
   C. Protein
   D. Vitamins
   E. Water

7. *Absorptive lipemia is due to ingestion of:*
   A. Sugars
   B. Proteins
   C. Starches
   D. Fats
   E. Calcium

8. *The recommended daily dietary allowance of protein for an average 70 kg male is:*
   A. 6.5 g
   B. 11 g
   C. 13 g
   D. 56 g
   E. 110 g

9. *Micelles*
   A. Are the same as emulsion droplets
   B. Formed from bile acids at all bile acid concentrations
   C. Although they are formed during lipid digestion, do not significantly enhance utilization of dietary lipid
   D. Always consist of only a single lipid species
   E. Are essential for absorption of vitamin A and K

10. *In the metabolism of bile acids:*
   A. The liver synthesizes the primary bile acids, cholic, and deoxycholic acids
   B. Secondary bile acids are produced by conjugation of primary bile acids to glycine or taurine
   C. Physiological active bile acids are formed from primary bile acids by intestinal bacteria
   D. Daily bile acid secretion by the liver is approximately equal to daily bile acid synthesis
   E. Conjugation reduces the polarity of bile acids, enhancing their ability to interact with lipids

11. *Which one of the following dietary components most strongly affects the risk of coronary artery disease?*
   A. Cholesterol
   B. Saturated fat
   C. Polyunsaturated fat
   D. Monounsaturated fat
   E. Trans fatty acids

12. *All of the following are observed in high-fiber diets EXCEPT:*
   A. Reduced incidence of constipation
   B. Decrease in blood cholesterol
   C. Increases frequency of hyperglycemia
   D. Decreased Zn^{++} absorption
   E. Increased intestinal motility

13. *Which one of the following contains the highest percent of monounsaturated fat?*
   A. Corn oil
   B. Soybean oil
   C. Olive oil
   D. Palm oil
   E. Coconut

14. *Which one of the following statements is CORRECT?*
   A. The Recommended Dietary Allowance is the minimal nutrient requirement for individuals
   B. Protein requirements per kilogram of body weight are constant throughout life
   C. Alcohol, like fat, providing 9 Kcal/g
   D. Thermic effect of food is the heat produced by the body during the digestion and absorption of food
   E. The basal metabolic rate typically accounts for 10% to 20% of the energy expenditure in a sedentary individual

15. *All of the following are widely accepted dietary recommendations EXCEPT:*
   A. Limit consumption of polyunsaturated fats to 10% or less of total calories
   B. Decrease consumption of saturated fats
   C. Increase consumption polyunsaturated fats
   D. Increase fiber consumption to 20 to 30 g per day
   E. Decrease consumption of total fats to less than 50% of total calories

16. *Given the information that a 70-kg man is consuming a daily average of 275 g of carbohydrate, 75 g of protein, and 65 g of lipid, one can draw which conclusion?*
   A. Total energy intake per day is approximately 3000 Kcal
   B. About 20% of the calories are derived from lipid
   C. The diet does not contain a sufficient amount of dietary fiber
   D. The proportions of carbohydrate, protein, and lipid in the diet conform to the recommendations of academic groups and government agencies
   E. The individual is in nitrogen balance

In the following questions indicate with clear (T) the true statements, and with clear (F) the false statements:

Kwashiorkor:

17. Is characterized by growth retardation, anemia, hypoproteinemia, edema, and fatty infiltration of the liver.
18. Symptoms respond therapeutically to a high protein diet containing considerable meat and milk products.
19. *It is due to dietary carbohydrate deficiency*
20. *It is due to dietary protein deficiency*
21. *Is a disease observed primarily in highly-developed industrial areas*

Dietary carbohydrate:

22. Animals and man can be maintained for periods of time on diets devoid of carbohydrate
23. Lactose supplies the major protein of the caloric value of milk
24. Lactose deficiency is a common cause of infants depending on a poor milk diet
25. Carbohydrate supplies about 10 to 30% of the calories of most human diets
26. Dietary calories per gram of carbohydrate is 7 Kcal

The biological value of a protein is determined in part by its:

27. Acidity or basicity
28. Digestibility
29. Phosphorus content
30. Amino acid composition
31. Polarity and nonpolarity

Severe protein deficiency causes:

32. Negative nitrogen balance
33. Decrease of RNA and DNA in liver
34. Complete loss of liver xanthine oxidase after 2 weeks
35. Sharply increased activity of the endocrine system
36. Generalized edema

Ferritin is found in:

37. Liver
38. Intestinal mucosa
39. Pancreas
40. Spleen
41. Bone

For plant and animal proteins:

42. The protein concentration of plants is higher than that of animals
43. Plant proteins are lower in lysine, methionine, and tryptophan than animal protein
44. Animals store amino acids as a reserve food
45. Animals synthesize protein only when the component amino acids are all present simultaneously
46. Plants contain proteins of high biological values

Matching: For each set of numbered questions, choose the ONE BEST answer from the list of lettered options below it. An answer may be used once or more times, or not at all.

47. *Attack cholesterol esters*
48. *Attacks α-1-4 glucosidic bond*
49. *Hydrolyzes triacylglycerols*
50. *Form micelles by combing with digested lipids*
51. *Appears in intestine during ingestion*

A. 2-Monoacylglycerols
B. Cholesterol esterase
C. Pancreatic lipase
D. Amylase
E. Bile acid

52. *Free energy of hydrolysis of one mole of a 250-amino acid residue protein*
53. *Free energy of oxidation to CO_2 of glucose (per mole)*
54. *Dietary calories per gram of fat*
55. *Daily caloric requirement for woman performing light housework*
56. *Hourly caloric requirement for man standing at rest*

A. 125 Kcal
B. 9 Kcal
C. 100 Kcal
D. 686 Kcal
E. 2500 Kcal

57. *Promotes acid secretion by the gastric mucosa*
58. *Promotes release of bile*
59. *Promotes secretion of $NaHCO_3$ by the pancreas*
60. *Inhibits acid secretion by the gastric mucosa*
61. *Vasodilator active in the gastric mucosa*

A. Cholecystokinin
B. Gastrin
C. Histamine
D. Prostaglandin E1
E. Secretin

62. *Sublingual salivary gland*
63. *Gastric mucosa*
64. *Excocrine pancreas*
65. *Duodenum*
66. *Gall bladder*

A. Amylase
B. Enteropeptidase
C. Pepsinogen
D. Co-lipase
E. Taurocholic acid

67. *Albumin*
68. *Ceruloplasmin*
69. *Prealbumin*
70. *Transcortin*
71. *Transferrin*

A. Thyroxine
B. Palmitic acid
C. Fe^{++}
D. Cu^{++}
E. 11-Dehydrocorticosterone

72. *Hypochromic anemia*
73. *Rickets*
74. *Muscular tremors*
75. *Caries*
76. *Acidosis*

A. Calcium
B. Potassium
C. Fluoride
D. Copper
E. Magnesium

77. *Liver*
78. *Pancreas*
79. *Spleen*
80. *Stomach*
81. *None of the above*

A. Has no role in digestion
B. Synthesizes an essential emulsifier of lipids
C. Participates in a nonessential manner in protein digestion
D. Transports HCO_3^- from the cytosol across the contraluminal plasma membrane
E. Site of chymotrypsinogen synthesis

Answer Key

MCQ:

1	2	3	4	5	6	7	8	9	10
A	D	B	D	A	C	D	D	E	C
11	12	13	14	15	16				
B	C	C	D	E	D				

True and false:

17	18	19	20	21	22	23	24	25	26
T	T	F	T	F	T	F	T	F	F
27	28	29	30	31	32	33	34	35	36
F	T	F	T	F	T	T	F	F	T
37	38	39	40	41	42	43	44	45	46
T	T	F	T	F	F	T	F	T	F

Matching:

47	48	49	50	51	52	53	54	55	56
B	D	C	E	A	A	D	B	E	C
57	58	59	60	61	62	63	64	65	66
B	A	E	D	C	A	C	D	B	E
67	68	69	70	71	72	73	74	75	76
B	D	A	E	C	D	A	E	C	B
77	78	79	80	81					
C	A	D	D	B					

Chapter 12

Mineral Metabolism Electrolyte and Water Balance

1. *What are bulk elements?*
   A. These are elements required in amounts greater than 100 mg/day.
2. *Enumerate bulk elements.*
   A. Calcium, phosphorus, magnesium, sodium, potassium, and chloride.
3. *What are trace elements?*
   A. These are elements required in amounts less than 100 mg/day.
4. *Enumerate trace elements.*
   A. Iron, copper, zinc, iodine, selenium, manganese, cobalt, chromium, molybdenum, and fluoride.
5. *What is the function of calcium?*
   A. Coagulation, neuromuscular activity, intracellular messenger, activation of enzymes, and bone formation.
6. *What is the daily requirement of calcium?*
   A. 500 mg per day.
7. *What are the sources of calcium?*
   A. Milk (the richest sources) , egg, fish, and vegetables.
8. *What factors promoting absorption of calcium from intestine?*
   A. Vitamin D, calcitriol, parathyroid hormone, high protein diet, and high dietary lactate and citrate that form soluble salts with calcium.
9. *What factors inhibiting absorption of calcium from intestine?*
   A. High dietary phosphate, oxalate and phytate which form insoluble salts with calcium. Excessive alkali intake and impaired fat absorption as fatty acids form insoluble calcium soaps with calcium.
10. *What are types of body calcium?*
    A. Body calcium is about 1200 g. Most of calcium is present in the bones and teeth, 99%, in the form of hydroxyapatitie (3 $Ca_3(PO4)_2.Ca(OH)_2$). The remaining 1% of calcium are present in body fluids and other tissues.
11. *What is the normal level of calcium in blood?*
    A. 8.5 – 10.5 mg / dl.

12. *May calcium present in red cells?*

A. No. As calcium lies entirely in the plasma.

13. *What are forms of plasma calcium?*

A. 3 forms, ionized diffusible (50%), non ionized diffusible (5%), and non ionized non diffusible (45%).

14. *Hypocalcemia (defeciency of ionized calcium) results in what clinical condition?*

A. Tetany.

15. *Which hormones will influence plasma calcium level?*

A. Calcitriol, calcitonin, and parathyroid hormone.

16. *What is the influence of parathyroid hormone on serum calcium level?*

A. It increases serum calcium level through bone resorption, increased absorption of calcium from intestines, and increased reabsorption of calcium from renal tubules.

17. *What is the influence of calcitriol on plasma calcium level?*

A. It increases blood calcium level through absorption of calcium from the intestine, reabsorption of calcium by renal tubules and mobilization of calcium from bones.

18. *What is the influence of calcitonin on plasma calcium level?*

A. This hormone is secreted by parafollicular or "C" cells of the thyroid gland. it decreases blood calcium level through inhibition of its mobilization from bones, or increasing calcium deposition in bones.

19. *What is the reason for tetany?*

A. Hypoparathyroidism.

20. *What are the features of hyperparathyroidism?*

A. Osteoporosis, hypercalciuria, and urinary calculi.

21. *What are the causes of hypercalcemia?*

A. primary hyperparathyroidism, tertiary hyperparathyroidism, excess intake of vitamin D or calcium or both, milk-alkali syndrome, bone diseases as malignancy, leukemia, multiple myeloma and Paget's disease, drugs as thiazide diuretics.

22. *Why milk alkali syndrome causes hypercalcemia?*

A. Patients who received, for long periods, excessive absorbable alkalies and milk (source of calcium), for the treatment of peptic ulcer may develop hypercalcemia. Calcium is insoluble in alkali medium.

23. *What are the causes of hypocalcemia?*

A. Hypoparathyroidism, alkalosis, kidney disease where activation of vitamin D is inhibited.

24. What is the effects of hypocalcemia

A. If ionized calcium is much decreased, tetany with carpopedal spasm results.

25. What is the normal level of phosphorus in blood?

A. 3 - 5 mg / dl.

26. What are the functions of phosphorus?

A. It enters in the structure of bones and teeth. It enters in the structure of the following cellular components: nucleic acids (DNA, RNAs), phospholipids, phosphoproteins, coenzymes as NAD^+, high energy phosphate compounds as ATP, carbohydrate intermediates as glucose-6-phosphate, and blood buffers (phosphate buffers).

27. What are factors affecting blood phosphorus?

A. Parathyroid hormone and active vitamin D "calcitriol".

28. What is the mechanism regulating blood phosphorus?

A. Parathyroid hormone decreases blood phosphorus by stimulating its excretion (through inhibiting its renal tubular reabsorption), active vitamin D "calcitriol" increases blood phosphorus through stimulation of absorption of phosphorus from the intestine, bone reabsorption and renal reabsorption by renal tubules.

29. What are the functions of magnesium?

A. It enters in the structure of skeleton (bones and teeth). It activates many enzymes e.g. kinase enzymes. It is required also for the active transport of other cations (Ca^{++}, Na^+, K^+) across the cell membrane. It is important for muscle contraction, nerve impulse transmission and it decreases neuromuscular excitability.

30. Which metal is required for the action of kinases?

A. Magnesium.

31. What is the major extracellular cation?

A. Sodium.

32. What is the major intracellular cation?

A. Potassium.

33. What is the major extracellular anion?

A. Chloride.

34. What is the major intracellular anion?

A. Phosphate.

35. What is the normal level of sodium in blood?

A. 136-145 mEq / L.

36. Which will control the sodium level in serum?

A. ADH, aldosterone , and cortisone.

37. *What are the functions of sodium?*

A. Maintenance of osmotic pressure and volume of plasma and extracellular fluid. It is important for transmission of nerve impulses, contraction of muscles and regulation of acid base balance.

38. *What is hypernatremia?*

A. Excess plasma sodium above normal concentration.

39. *What are causes of hypernatremia?*

A. (1) Cushing syndrome: due to excessive glucocorticoids. (2) Conn's disease: due to excessive aldosterone secretion. (3) Diabetes insipidus: due to rapid loss of water. (4) Drugs: as ACTH or cortisone.

40. *What is hyponatremia?*

A. Decrease plasma sodium below normal concentration.

41. *What are causes of hyponatremia?*

A. (1) Addison's disease: due to deficiency of aldosterone. (2) Renal failure: where renal reabsorption of sodium is inhibited. (3) Hypotonic dehydration: where loss of water and sodium (electrolytes) is treated by administration of water only. (4) Diuretics e.g. thiazides which block tubular reabsorption of sodium.

42. *What is the normal level of potassium in blood?*

A. 3.5 to 5 mEq / L.

43. *What are the functions of potassium?*

A. Maintenance of osmotic pressure and volume of intracellular fluid. It is important for transmission of nerve impulses, contraction of muscles and regulation of acid base balance.

44. *What is hyperkalemia?*

A. Excess plasma potassium above normal concentration.

45. *What are causes hyperkalemia?*

A. (1) Addison's disease: due to deficiency of aldosterone (2) Acidosis (respiratory or metabolic), due to shift of K^+ from intra to extracellular in exchange with H^+ (3) Tissue necrosis: e.g. major trauma and burns due to leakage of tissue contents of potassium (4) Chronic renal failure associated with oliguria (5) Uncontrolled diabetes mellitus: the lack of insulin prevents K^+ from entering.

What is acute hyperkalemia?

A. If plasma K^+ gets more than 6.5 mEq/L, cardiac arrhythmias and even cardiac arrest may result.

46. *What is hypokalemia?*

A. Decreased plasma potassium below normal concentration.

47. *What are causes of hyporkalemia?*

A. (1) Alkalosis (respiratory or metabolic) (2) Treatment of hyperglycemia by insulin without giving potassium because insulin helps K^+ to enter cells (3)

Excessive vomiting and diarrhea (4) Cushing syndrome due to excessive glucocorticoids (5) Primary and secondary aldosteronism (6) Diuretic therapy.

48. *What is the manifestation of hypokalemia?*

A. In ECG, T wave inverted, ST segment is lowered.

49. *What is hypochloremia?*

A. Decreased plasma chloride below normal concentration. It Results from excessive vomiting.

50. *What is the normal level of chloride in blood?*

A. 96-106 mEq / L.

51. *What are the functions of chloride?*

A. (1) Chloride is the main extracellular anion. Together with sodium, It maintains the osmotic pressure and volume of plasma and extracellular fluid. (2) Chloride ions is essential for formation of HCl in the stomach. (3) Activation of enzymes: Cl^- activates salivary and pancreatic amylase enzymes.

52. *Chloride ions activate which enzyme?*

A. Amylase.

53. *What are the effects of hypochloremia?*

A. It leads to decrease plasma chloride and increase plasma bicarbonate as compensatory mechanism, causing alkalosis. This type of alkalosis is called: hypochloraemic alkalosis.

54. *What are the functions of iron?*

A. Enters in the structure of hemoglobin, myoglobin, respiratory enzymes, and cytochrome P_{450}.

55. *Name some iron containing enzymes.*

A. Cytochrome oxidase catalse, peroxidase, xanthine oxidase.

56. *What is the daily requirement of iron for a normal adult male?*

A. 10-20 milligram per day.

57. *What are the dietary sources of iron?*

A. Green leafy vegetables, and meat.

58. *Which is the trace element, deficient in milk?*

A. Iron.

59. *What are important iron cotaining proteins?*

A. Hemoglobin, myoglobin, cytochromes, catalase, tryptophan pyrrolase, xanthine oxidase, transferrin, and ferritin.

60. *Which will increase iron absorption from intestines?*

A. Gastric HCl, ascorbic acid, and cysteine.

61. *What are the factors which will retard iron absorption?*

A. Phytic acid (in cereals), oxalic acid (in leafy vegetables), calcium, zinc, lead and phosphates.

62. Iron is absorbed from which part?

A. Upper part of duodenum.

63. How is iron absorbed?

A. Iron in the intestinal lumen enters the mucosal cell in the ferrous state. This is bound to transferrin molecule present in brush border surface of intestinal cell. One transferrin molecule can bind with two atoms of iron. This is then complexed with a specific receptor. This iron-transferrin receptor is internalised.

64. How iron absorption is regulated?

A. When iron stores in the body are depleted, absorption is enhanced. When adequate quantity of iron is stored, absorption is decreased. This is referred to as "mucosal block" of regulation of absorption of iron.

65. What is the carrier protein of iron in blood?

A. Transferrin.

66. What is transferrin?

A. This is an iron carrying glycoprotein synthesized in the liver. Each molecule can carry 2 atoms of iron in ferric state (Fe^{+++}).

67. What is total iron binding capacity (TIBC)?

A. The maximum amount of iron that is carried by plasma transferrin. It is 180 – 450 ug iron/dl.

68. What is the normal plasma iron?

A. 60-160 iron mg/dl.

69. How much transferrin is saturated by iron?

A. Only 30% of the TIBC of transferrin is saturated.

70. What are clinical conditions in which plasma iron and TIBC are altered?

A. In iron deficiency anemia: plasma iron is decreased. And TIBC is increased. In liver diseases: decrease plasma iron and decrease TIBC. In iron overload: increased plasma iron and decreased total iron binding capacity.

71. What is the storage form of iron?

A. Ferritin.

72. What is the structure of ferritin?

A. It is formed of a protein called apoferritin, which can carry a 24 atoms of iron to form ferritin.

73. What are storage sitess of ferritin?

A. It is present in iron stores: liver, spleen, bone marrow and intestine.

74. What are clinical implications of measuring plasma ferritin?

A. It gives a good idea about body iron stores. A low plasma ferritin indicates the presence of depleted iron stores as in iron deficiency anemia. A raised plasma ferritin is found in iron overload and also in many patients with liver disease and cancer.

75. Which enzyme will help in iron carriage in blood?

A. Ceruloplasmin (Ferroxidase).

76. *What are causes of iron deficiency anemia.*

A. Deficient intake, impaired absorption as in steatorrhea, excessive loss as menstrual loss, gastro-intestinal bleeding, bleeding due to some parasites (anchylostoma).

77. *Iron deficiency results in what type of anemia?*

A. Microcytic hypochromic anemia.

78. *What are biochemical changes in iron deficiency anemia.*

A. Plasma iron is decreased, plasma TIBC is increased, plasma ferritin is decreased and RBCs show hypochromic microcytic cells.

79. *Anemia results in the deficiency of which substances?*

A. Iron, copper, vitamin C, folic acid, vitamin B12, and pyridoxal phosphate.

80. *What are causes of iron over load (hemosiderosis)?*

A. Repeated blood transfusion, intravenous administration of iron, and hemochromatosis (hemosiderosis, bronze diabetes).

81. *What is hemosiderin?*

A. Excess iron is loaded as hemosiderin. When body contains very high content of iron more than the capacity of apoferritin, some of iron is found in granules called hemosiderin. These granules are composed of iron, protein, and polysaccharides.

82. *What are the features of hemosiderosis?*

A. Cirrhosis of liver, diabetes mellitus, and yellow color of skin.

83. *What are biochemical changes in iron over load?*

A. Plasma iron is increased, plasma TIBC is decreased, and plasma ferritin is increased.

84. *How much total body iron?*

A. 3 – 5 g in adult male.

85. *How total body iron is distributed?*

A. RBCs iron (hemoglobin) 66%, tissue iron (33%) and plasma iron 1%.

86. *What are tissue iron?*

A. Available forms (29%) i.e. can be used by tissues when there is body need, and non-available forms (4%), cannot be used even if there is body needs.

87. *What are available forms?*

A. ferritin, hemosiderin.

88. *What are non-available forms?*

A. All these forms are hemoproteins i.e. contains heme ring. They include myoglobin, respiratory cytochromes (b, c_1, c, a, a_3), catalase, peroxidase, tryptophan oxygenase (pyrrolase) and cytochrome P_{450}.

89. *What is haptoglobin?*

A. It is the carrier of free hemoglobin.

90. *What is hemopexin?*

A. It is the carrier of free heme.

91. *What are dietary sources of copper?*

A. Cereals, meat, and liver.

92. *What are the functions of copper?*

A. Hemoglobin synthesis, bone formation, maintenance of myelin of the nerves, and copper is essential constituent of several metaloenzymes.

93. *What are the important copper containing metaloenzymes?*

A. Ceruloplasmin, cytochrome oxidase, cytochrome C, tyrosine hydroxylase, lysyl oxidae, and super oxide dismutase.

94. *What is ceruloplasmin?*

A. It is ferroxidase, and it promotes oxidation of ferrous ion to ferric form in serum.

95. *What are the characteristic features of Wilson's hepatolenticular degeneration?*

A. Ceruloplasmin and copper levels in blood is decreased, copper excretion by kidneys is increased, and copper is accumulated in tissues leading to damage in the liver, kidneys, brain, and eyes.

96. *What are the causes of Wilson's disease?*

A. It is due to either excessive copper absorption from intestine or inadequate excretion of copper in bile.

97. *What is the manifestations of liver damage of Wilson's disease?*

A. Cirrhosis and liver failure.

98. *What is the eye manifestations in Wilson's disease?*

A. Accumulation of copper in cornea produces greenish-brown discoloration of the corneal margin which is called Kayser-Fleisher rings.

99. *What is the brain manifestations in Wilson's disease?*

A. Accumulation of copper in lenticular nucleus of the brain produces lenticular degeneration with abnormal movement.

100. *What is the renal manifestations in Wilson's disease?*

A. Accumulation of copper in kidney produces renal tubular damage with excessive loss of copper and ceruloplasmin and Increased excretion of amino acids → aminoaciduria.

101. *What is hypercupremia?.*

A. Hypercupremia is an excess plasma copper and ceruloplasmin. Ceruloplasmin is considered as acute phase protein i.e. its plasma level is increased in infections and malignancy.

102. What is the daily requirement of zinc?

A. 15 - 20 milligram.

103. What are the functions of zinc?

A. Growth and reproduction. It plays a role in tissue repair and wound healing. Zinc forms a complex with insulin. Zinc is essential component of a number of enzymes. Zinc is required for vitamin A.

104. What are the important zinc containing enzymes?

A. Alkaline phosphatase, carbonic anhydrase, superoxide dismutase, carboxypeptidase amylase, and RNA polymerase.

105. What is the relationship between zinc and vitamin A?

A. Zinc is required for mobilization of vitamin A from the liver and subsequently maintain the normal concentration of vitamin A in plasma.

106. What are the important enzymes which contain zinc?

A. Alkaline phosphatase, amylase, carbonic anhydrase, and RNA polymerase.

107. What are the functions of iodine?

A. Formation of thyroid hormones ($T_3 - T_4$).

108. What is the daily requirement of iodine?

A. 150-200 microgram.

109. What is the importance of selenium?

A. It is an anti-oxidant.

110. Name the selenium containing enzyme.

A. Glutathione peroxidase.

111. What are the functions of manganese?

A. Normal bone structure, reproduction (spermatogenesis and ovulation), normal function of central nervous system and it activates arginase enzyme.

112. What are the functions of cobalt?

A. Cobalt is a component of vitamin B_{12} which is necessary for normal blood cell formation.

113. What are enzymes requiring vitamin B_{12}?

A. Methylmalonyl CoA mutase, methyltetrahydrofolate oxidoreductase, homocysteine methyltransferase, ribonucleotide reductase.

114. What gives vitamin B12 its red color?

A. Cobalt.

115. Which enzyme contains molybdenum?

A. Xanthine oxidase.

116. What are the functions of flourine?

A. It increases the hardness of bones and teeth.

117. What is manifestation of flourine deficiency?

A. Dental carries.

118. *What is Fluorosis?*

A. It is produced when fluoride concentration in water is more than 20 ppm. Osteoporosis is the manifestation.

119. *What is the function of anti diuretic hormone?*

A. Its secretion is stimulated when plasma osmolarity increases, ADH decreases the urine output, and retains water in the body.

120. *What are the factors regulating fluid and electrolyte balance?*

A. Aldosterone and anti diuretic hormone.

121. *What are the diuretic drugs used?*

A. Aldosterone antagonists, angiotensin converting enzyme inhibitors, and carbonic anhydrase inhibitors.

122. *What is the major cause for isotonic contraction of ECF?*

A. Small intestinal obstruction.

123. *What are the causes for hypotonic contraction of ECF?*

A. Infusion of dextrose (without saline), Addison's disease.

124. *What are the causes for hypertonic contraction of ECF?*

A. Diarrhea, vomiting.

125. *What are the causes for isotonic expansion of extracellular fluid?*

A. Congestive cardiac failure and hyperaldosteronism.

126. *What is the cause for hypotonic expansion of extracellular fluid?*

A. Inappropriate secretion of ADH.

127. *What is the important cause for hypertonic expansion of ECF?*

A. Cushing's syndrome.

128. *What are the metabolic imbalances seen in diarrhea?*

A. Metabolic acidosis, hypertonic contraction of ECF, urine with high specific gravity, and urine output reduced.

MCQ, Matching, true and false and Completion

Select and encircle the most appropriate answer or completion:

1. *Total iron binding capacity is:*
   A. Plasma iron binding protein.
   B. Storage form of iron.
   C. Total amount of iron that can be stored in the iron stores.
   D. Maximum amount of plasma iron that can be carried by transferrin.
   E. Minimum amount of plasma iron that can be carried by transferrin.

2. *Sodium is:*
   A. Intracellular cation
   B. Extracellular cation
   C. Intracellular anion
   D. Extracellular anion

3. *Calcium absorption needs vitamin:*
   A. A
   B. E
   C. C
   D. D

4. *All the following proteins contain iron EXCEPT:*
   A. Hemoglobin
   B. Myoglobin
   C. Cytochrome c
   D. Ceruloplasmin
   E. Ferritin

5. *All the following proteins contain porphyrin ring EXCEPT:*
   A. Hemoglobin
   B. Myoglobin
   C. Cytochrome
   D. Catalase
   E. Peroxidase

6. *Iron containing protein is :*
   A. Ferritin
   B. Apoferritin
   C. Transferrin
   D. All of the above
   E. None of the above

7. *A trace element is:*
   A. Magnesium
   B. Chlorine
   C. Iron
   D. Sodium
   E. Phosphorus

8. *Copper is transported in plasma in the form of:*
   A. Cuprcyanin
   B. Ferrtin
   C. Ceruloplasmin
   D. Hepatocuprin
   E. Erythrocuprin

9. *Hypercalcemia may be caused by all the following EXCEPT:*
   A. Excessive secretion of calcitonin
   B. Primary hyperparathyroidism.
   C. Hypervitaminosis D.
   D. Drugs as thiazide diuretics.
   E. Bone diseases as in malignancy.

10. *All the following inhibits calcium absorption EXCEPT:*
   A. High phosphate containing diet.
   B. High protein containing diet.
   C. High oxalate containing diet.
   D. High fatty acid containing diet.
   E. Alkalinity.

11. *The following cause a decrease in serum phosphate EXCEPT::*
   A. Vitamin D deficiency.
   B. Renal tubular disease.
   C. Hypoparathyroidism.
   D. Chronic alcoholism.
   E. Excessive use of antacids.

12. *Zinc is a consitituent of all the following EXCEPT:*
   A. Ceruloplasmin
   B. RNA polymerase
   C. Carbonic anhydrase
   D. Carboxy peptidase
   E. superoxide dismutase

13. *Addison's disease is associated with:*
   A. Hyperkalemia and hypernatermia.
   B. Hyperkalemia and hyponatermia.
   C. Hypokalemia and hypernatermia.
   D. Hypokalemia and hyponatermia.

14. *Among the elements needed by the body are:*
   A. Iodine, chromium and cobalt.
   B. Copper, fluoride and iron.
   C. Manganese molybdenum and selenium.
   D. All of the above.

15. *A rise in blood calcium and phosphate indicates:*
   A. Vitamin C deficiency.
   B. Vitamin D deficiency.
   C. Hypervitaminosis D.
   D. Cushing's disease.

16. *A plasma protein carrying copper is:*
   A. Transferrin.
   B. Transcortin.
   C. Ceruloplasmin.
   D. Pre-albumin

17. *Plasma calcium can be regulated by all the following hormones EXCEPT:*
    A. Calcitriol
    B. Thyroid hormones
    C. Parathyroid hormone
    D. Calcitonin

18. *The most abundant mineral in the body is:*
    A. Iron.
    B. Zinc.
    C. Calcium.
    D. Sodium.

19. *In Wilson's disease there is a deficiency of:*
    A. Calcium.
    B. Copper.
    C. Sodium.
    D. Zinc.

20. *Transferrin is:*
    A. Plasma iron binding protein.
    B. Storage form of iron.
    C. Hemoprotein containing single heme ring.
    D. Intestinal carrier for iron absorption.

21. *Which of the following minerals help crystallization, storage and release of insulin:*
    A. Selenium.
    B. Chromium.
    C. Zinc.
    D. Potassium.

22. *Which finding about iron deficiency anemia is incorrect:*
    A. Plasma iron is decreased.
    B. Plasma TIBC is decreased.
    C. Plasma ferritin is decreased.
    D. RBCs are hypochromic and microcytic.

Matching: For each set of numbered questions, choose the ONE BEST answer from the list of lettered options below it. An answer may be used once or more times, or not at all.

23. *Main intracellular cation*
24. *Main intracellular anion.*
25. *Main extracellular cation.*
26. *Main extracellular anion.*
27. *Component of glutathione peroxidase*
    A. Sodium
    B. Potassium
    C. Selenium
    D. Manganese
    E. Magnesium
    F. Calcium
    G. Chloride
    H. Phosphat

Match the the numbered hormone or enzyme with lettered mineral component as they best fit together

28. *Insulin*
29. *B_{12}*
30. *thyroxine*
31. *ceruloplasmin*
32. *Glutathione peroxidase*

A. manganese
B. zinc
C. Selenium
D. Cobalt
E. Iodine
F. molybednum
G. copper

33. *Iodine*
34. *Cobalt*
35. *Fluoride*
36. *Selenium*

A. Prevents dental carries and osteoprosis.
B. Enters in the formation of thyroid hormones.
C. Acts As antioxidant.
D. is a component of vitamin B_{12}.

Answer Key

MCQ:

1	2	3	4	5	6	7	8	9	10
D	B	D	D	E	A	C	C	A	B
11	12	13	14	15	16	17	18	19	20
C	A	B	D	C	C	B	C	B	A
21	22								
C	B								

Matching:

23	24	25	26	27	28	29	30	31	32
B	H	A	G	C	B	D	E	G	C
33	34	35	36						
B	D	A	C						

Chapter 13 — Physical Chemistry and Applications of Radioisotopes in Medicine.

1. *What is an Isotope?*

   A. Isotopes of a given element will have different atomic weights, but will have the same atomic number.

2. *What are types of isotopes?*

   A. Stable isotopes as oxygen 16, 17 and 18 (O^{16}, O^{17}, O^{18}) and radioactive isotopes (which emit radiations from the nucleus) as α and β particles and γ rays.

3. *Radiation hazard is mainly due to which type of radiation?*

   A. α-Radiation.

4. *Iodine-125 emits mainly which type of radiation?*

   A. δ-Radiation.

5. *What is the isotope used for DNA studies?*

   A. P^{32}.

6. *What are uses of isotopes?*

   A. (1) Diagnosis as I^{131} used in diagnosis of thyroid gland diseases, (2) Treatment as radioactive materials may treat many cancers, which cannot be operated upon and (3) research as radioactive material can be introduced into the body and traced to know its fate in the body.

7. *P^{32} is used clinically for what purpose?*

   A. To treat polycythemia vera (increased platelets number).

8. *Which radioactive compound is used to measure glomerular filteration rate(GFR)?*

   A. Iodine^{131} (I^{131}).

9. *Which radioactive compound is used to diagnose thyroid gland diseases?*

   A. Iodine^{131} (I^{131}).

10. *For RIA (radio immunoassay), which the radioactive isotope used?*

A. Iodine^{125} (I^{125}).

11. *What is the use of radioactive radium in medicine?*

A. Radiation treatment of some malignant diseases, such as carcinoma of cervix or body of uterus.

12. *What are radiosensitive tumors?*

A. Lymphomas, Hodgkin's disease and neuroblastoma are highly radiosensitive.

13. *What are the important toxic effects of radiation?*

A. Leucopenia, thrombocytopenia, and radiation dermatitis. ← التهاب الجلد

14. *What is an element?*

A. A substance formed of one type of atoms only. Elements are either metals as iron or non-metals as chlorine.

15. *What are acids?*

A. Substances that give hydrogen ions or protons in solution.

16. *What are types of acidity?*

A. True acidity and titratable acidity. ← الحموضة

17. *What is pK of an acid?*

A. pK is the negative logarithm of the dissociation constant of the acid to the base 10.

18. *What is pH?*

A. pH is the negative logarithm of hydrogen ions concentration to the base 10

19. *What are alkalis?*

A. Alkalis are substances that give (-OH) hydroxyl ions in solution.

20. *What is base?*

A. Substance, which accepts (H^+) proton.

21. *What is buffer?*

A. Buffer is a solution, which resists changes in pH when an acid or alkali is added to it. Buffers are usually a mixture of a weak acid with its salt of strong base, or mixture of a weak base and its salt of strong acid e.g. carbonic acid and sodium bicarbonate ($H_2CO_3/NaHCO_3$).

22. *What are plasma buffers?*

A. Bicarbonate buffer: $NaHCO_3/H_2CO_2$, phosphate buffer: Na_2HPO_4/NaH_2PO_4, and plasma proteins: Sodium proteinate / H protein.

23. *What are blood buffers?*

A. Bicarbonate buffer: $KHCO_3$ / H_2CO_3, hemoglobin buffer: KHb / HHb, and oxyhemoglobin buffer: $KHbO_2$ / $HHbO_2$.

24. *What is indicator?*

A. It is a solution of weakly ionized organic acid. It changes color with changes in pH. It is used for determination of pH of solutions and end point of acid-base titration. → المعايرة

25. *What are units of mass?*

A. Grams, moles or equivalents.

26. *What is unit of concentration?*

A. Molarity or normality.

27. *What is mole?*

A. It is the amount (weight) of substances (in grams) equal to its molecular weight.

28. *What is molar solution?*

A. Is the solution, which contains one mole of the solute, dissolved in one liter of solvent.

29. *What is normal solution?*

A. Is the solution, which contains one gram equivalent of the solute dissolved in one liter of solvent.

30. *What is colloids?*

A. Are solutions in which the size of particles ranges from one to 100 nanometers. They are either emulsoid or suspensoids.

31. *What are crystalloids?*

A. Are solutions in which the size of particles is less than one nanometer.

32. *What are suspensions?*

A. Are solutions in which the size of particles is more than 100 nanometer.

33. *What are factors causing stability of colloids?*

A. Presence of similar charges on all particles (repelling each other), brownian movement (keep the particles distributed in the whole system), and presence of fluid film around the particles.

34. *Which is more stable emulsoids or suspensolds?*

A. Emulsiods are more stable than suspensoids.

35. *What are the general properties of colloids?*

A. Tyndall effect, brownian movements, viscosity, osmotic pressure, gel formation, imbibition, and syneresis → انكماش

36. *What is tyndall effect?*

A. Any colloidal solution appears cloudy to the eye if a beam of light is passed through it. This is due to reflection of light by colloidal particles in solution.

37. *What is brownian movement?* اهتزازية

A. This is the continuous and strong vibratory movement due to the bombardment of colloidal particles by the molecules of solvent (like a game of billiards). The small particles move more easily than the big ones. ← قصف

38. *What is surface tension?*

A. It is the force that holds the surface molecules of a liquid together and attracted them toward the body of the liquid.

39. *What is emulsification?*

A. This is the breakdown of large fat globules in water into small ones to form emulsion. Substances which lower the surface tension of water can act as emulsifying agent e.g. bile salts, soap, and proteins.

40. *What is hydrotrophy?*

A. It is the capacity of a certain substance to make water insoluble substance more soluble in water e.g. bile salts render fats and fatty acids soluble in water, so, they are easily absorbed.

41. *What are hydrotropic factors?*

A. Substances, which make water insoluble substance more soluble in, water e.g. bile salts, phospholipids and glucuronic acid.

42. *What is lipotropic factor?*

A. Are substances, which help the mobilization of fats from the liver and so prevent fatty liver e.g. methionine, choline, inositol.

43. *What is adsorption?*

A. It is capacity of substance to make other substance closely attached to its surface (=adsorbed on it). This is due to the presence of attractive forces on the surface of adsorbing agent.

44. *What is imbibition?*

A. It is the ability of some colloids (e.g. gelatin) to take water and swell.

45. *What is elusion?*

A. Is the recovery of adsorbed material from adsorbing agent.

46. *What is dialysis?*

A. It is the separation of colloids from crystalloids using a semi permeable membrane.

47. What is ultrafiltration?

A. It is filtration through semi-permeable membrane. It is used for separating a crystalloid from its mixture with a colloid: crystalloid are filterable while colloids are not filterable.

48. What is ultracentrifugation?

A. This is a method for fractionation (separation) of a mixture of proteins (colloids). It is simply a type of centrifugation, done at high speed and at low temperature. Therefore, that proteins of different molecular weights will sediment at different rates and separated from each other.

49. What is electrophoresis?

A. If a colloidal solution e.g. a protein solution is subjected to an electric field, the particles will migrate either to anode or to cathode depending on their charges. This migration in the electric field is known as electrophoresis. This method is used for separation (fractionation) of different proteins present in one solution e.g. plasma proteins are separated into 5 fractions.

50. What is chromatography?

A. Is a technique used for separation of proteins, amino acids and some other substances. It depends on adsorption of the particles on the surface of special papers or gels and its subsequent separation by elution.

51. What is syneresis?

A. It is the process by which a gel can retract with release of its fluid content e.g. retraction of a blood clots with oozing (release) of serum.

52. What is diffusion?

A. Diffusion is the distribution of particles by simple agitation i.e. all molecules are in state of an agitated motion by which diffusion occurs.

53. What is osmotic pressure?

A. Is the hydrostatic pressure needed to prevent osmosis.

54. What is osmosis?

A. Is the passage of solvent molecules from lower to higher concentration through semi-permeable membrane i.e. membrane of certain pores that allows the passage of small particles (solvent particles) and prevents the passage of large particles (solute particles).

55. What is osmolality?

A. It is the concentration of a substance per mass solution (concentration of substance/Kg water).

56. What is osmolarity?

A. It is the concentration of a substance per volume solution (concentration of substance /liter water). As the volume varies with change in temperature, so osmolarity depends on temperature.

57. What are factors affecting osmotic pressure?

A. Number of dissolved particles and number of ions. The greater the number the higher the osmotic pressure.

58. What are physiological importance of osmotic pressure?

A. Urine formation, reabsorption of interstitial fluid and hemolysis.

59. How can osmotic pressure affect urine formation?

A. Inside the glomerular capillaries, there are 2 opposing forces; filtration force = +35 mm Hg (caused by capillary blood pressure) and reabsorption force = - 20 mm Hg (caused by osmotic pressure of plasma proteins). So, the net filtration pressure = + 35 – 20 = +15 mm Hg.

60. Why urine formation is stopped in cases of shock?

A. Under conditions of shock where capillary blood pressure is much decreased, filtration stops and anuria results until blood pressure is restored.

61. How can osmotic pressure affect reabsorption of interstitial fluid?

A. The interstitial fluid is formed by filtration of the blood plasma at the arterial end of the blood capillaries, and is reabsorbed at the venous end. At the arterial end, blood pressure is greater than that of osmotic pressure of plasma proteins. This leads to formation of interstitial fluid. At the venous end, blood pressure is less than that of osmotic pressure of plasma proteins. This leads to reabsorption of interstitial fluid.

62. What is hemolysis?

A. Hemolysis is the destruction of red blood cells followed by liberation of hemoglobin into the plasma.

63. What are causes of hemolysis?

A. Hemolysis may be caused by toxins, various chemical agents or enzymes deficiency.

64. *What is viscosity?*

A. It is the resistance offered by the fluid to flow. It is due to the internal friction between molecules of the fluid.

65. *What are factors affecting viscosity?*

A. Temperature (viscosity decreases with the rise of temperature and vice versa), solute concentration and size (viscosity increases with increase in both concentration and size of solutes and vice versa),

66. *What are causes of blood viscosity?*

A. It is due to plasma proteins, red and white cells.

67. *What is the medical importance of viscosity?*

A. Viscosity determines blood pressure. In anemia and hypo-proteinemia viscosity decreases. In polycythemia viscosity increases.

68. *What is Henderson-Hasselbach equation?*

A. It is the equation by which pH of a buffer solution can be calculated.

69. *Give an account on classification of solutions*

A. According to size of dispersed phase particles, solution may be classified into (1) Crystalloids = true solutions: Size of particles = less than 1.0 nm e.g. NaCl solution. (2) Colloids (include suspensoids and emulsiods: Size of particles = 1 – 200 nm. e.g. starch solution, gelatin solution, albumin solution, etc. (3) Emulsions and suspensions: Size of particles more than 200 nm. e.g. emulsion of oil in water, suspension of red cells in saline.

70. Compare between emulsiods and suspensopids.

	Emulsiods	Suspensoids
Solubility	Solvent lovers (lyophilic)	Solvent haters (lyophobic)
Stability	They have 2 stability factors	They have one stability factor
Precipitation	Difficult to precipitate	Easy to precipitate
Viscosity	More viscous	Less viscous
Tyndall effect	More marked	Less marked
Brownian movement	Less marked	More marked
Example	Starch solution Egg white solution	Colloidal gold Colloidal iron